B A N I S T E R I A

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

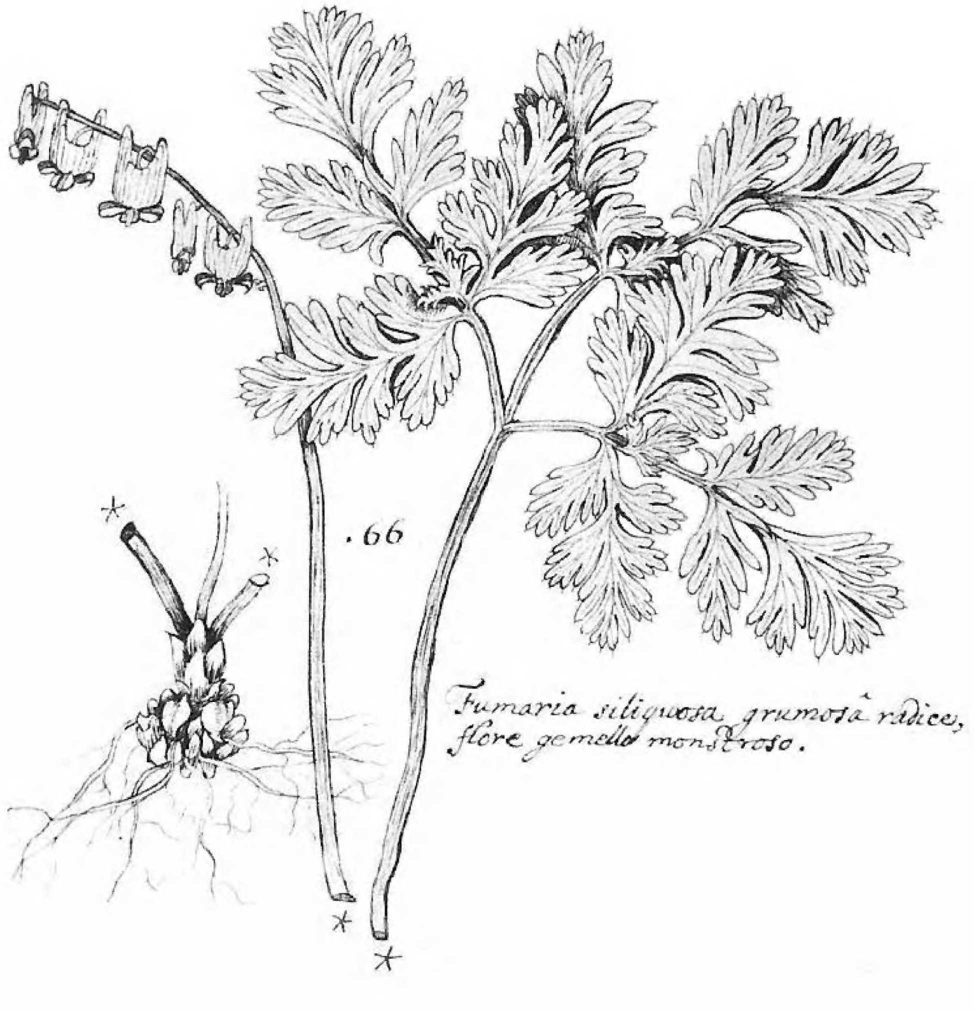

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Figure 59 in folio in Hans Sloane's MS 4002 in the British Museum of Natural History.

Back cover: Virginia Meadowbeauty, *Rhexia virginica* L. Original drawing by John Banister.
Figure 63 in folio in Hans Sloane's MS 4002 in the British Museum of Natural History.

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An Annotated List of the Caddisflies (Trichoptera) of Virginia: Part II. Families of Integripalpia

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ABSTRACT

One hundred forty-five species of caddisflies in the families Apataniidae, Brachycentridae, Calamoceratidae, Goeridae, Helicopsychidae, Lepidostomatidae, Leptoceridae, Limnephilidae, Molannidae, Odontoceridae, Phryganeidae, Sericostomatidae, and Uenoidae are listed for Virginia, of which 27 were not previously known for the state, bringing the total number of verified resident species known from the Commonwealth to 351. Counties of known occurrence are given for all species; detailed collection data are provided for rare species, those which constitute substantial range extensions, and those new to the state list. The distribution of each genus and species is also summarized.

Key words: Apataniidae, Brachycentridae, caddisfly, Calamoceratidae, Goeridae, Helicopsychidae, Lepidostomatidae, Leptoceridae, Limnephilidae, Molannidae, Odontoceridae, Phryganeidae, Sericostomatidae, Trichoptera, Uenoidae, Virginia.

This is the second installment of a three-part treatise on the caddisflies (Trichoptera) of Virginia. For background and general remarks, please refer to the introductory sections in Part I (Flint et al. 2004. An annotated list of the caddisflies (Trichoptera) of Virginia: Part I. Introduction and families of Annulipalpia and Spicipalpia. Banisteria 24: 23-46), in which 203 species in the families Dipseudopsidae, Glossosomatidae, Hydropsychidae, Hydroptilidae, Philopotamidae, Psychomyidae, and Rhyacophilidae known to occur in Virginia were listed with emphasis on their geographical distribution. The present treatment lists the species of the remaining families, with additions and corrections for those accounted in Part I. A summary conclusion with analyses of biogeographical patterns is now in preparation as the third and final part of this series, which will include a reference list relevant to all three parts.

Because several new depositories are mentioned in this paper, we give a complete listing of all of the acronyms used in both parts: BLRI – Blue Ridge Parkway, Jackie Holt; CMNH – Carnegie Museum of

Natural History, John E. Rawlins; CSU – Colorado State University, Boris C. Kondratieff; CUAC – Clemson University, John C. Morse; DER – David E. Ruiter personal collection; GWMP – George Washington Memorial Parkway, Brent Steury; INHS – Illinois Natural History Survey, H. H. Ross and Ed DeWalt; MCZ – Museum of Comparative Zoology, Phillip D. Perkins; NMNH – National Museum of Natural History, Oliver S. Flint, Jr.; ROM – Royal Ontario Museum, Glenn B. Wiggins; UT – University of Tennessee, David A. Etnier; VMNH – Virginia Museum of Natural History, Richard L. Hoffman; VPISU – Virginia Polytechnic Institute and State University, Charles R. Parker and J. Reese Voshell; WVU – West Virginia University, John S. Strazanac.

The names of species documented for Virginia for the first time are prefixed with an asterisk (*). The abbreviation "T.L." refers to type locality; BLT and UV denote captures at blacklight traps and ultraviolet light, respectively.

Family Apataniidae

Genus *Apatania*

The genus is widely distributed across the Northern Hemisphere, with more than a dozen species known for North America. A second apataniid genus, *Manophylax,* will probably be found in the state as *M. altus* (Huryn & Wallace) is known from North Carolina and *M. butleri* Schuster from Kentucky, Tennessee, and West Virginia, adjacent Appalachian states.

Apatania incerta (Banks): The species is widely distributed throughout northeastern United States and adjacent Canada as far west as Minnesota and south to the southern Appalachians. In the state, it is known from only a few localities in the northern Piedmont west into the Alleghanies. Like the other eastern species, *A. incerta* is rarely taken because it flies very early in the year. Bath, Craig, Fauquier, Floyd, Giles, Highland, Montgomery, Patrick, Rappahannock cos., Mar - Jun.

Family Beraeidae

This rather small family of small caddisflies is found throughout the Northern Hemisphere. Three species of *Beraea* are known from eastern North America, distributed from Ontario to Georgia; at least one of them will almost certainly be found in the state. The larvae live in slow-flowing, muck-filled springs.

Family Brachycentridae

Genus *Adicrophleps*

The genus includes only a single species limited to eastern North America.

Adicrophleps hitchcocki Flint: The species has a restricted distribution in northeastern United States from Connecticut to Virginia. It has been taken several times in the Northern Blue Ridge in Virginia where it inhabits small montane streams. Albemarle, Bedford, Madison, Nelson, Rappahannock, Rockbridge cos., Apr- May.

Genus *Brachycentrus*

The genus is represented throughout the Northern Hemisphere by approximately 28 species, of which 14 are found in North America. Seven of these have been taken in Virginia. The following records include all data, adult and larval, in Flint (1984).

Brachycentrus appalachia Flint: The species is widely distributed along the Appalachian Mountains of eastern North America from southern Canada to northern Georgia. In Virginia it is known from the Blue Ridge and Alleghanian provinces. All of the records are based on larval collections made from August through October, with pupae taken in April. Adults should be in flight from late April through May. Alleghany, Bath, Highland, Madison, Smyth cos.

Brachycentrus incanus Hagen: This species is known from southern Ontario to northern Virginia. The type specimen of this species was taken in Washington, DC in the mid-1800s. In recent years, only *B. nigrosoma* has been taken along the Potomac River in the Washington area. However, *B. incanus* was found swarming around the Potomac at Point of Rocks, MD in 2004, permitting the assumption that the species surely occurs on the Virginia side of the river. The Virginia collections are old and taken near the Potomac River. [Fairfax Co.], Great Falls, 15 April [no year given], 1♂, 2♀ (MCZ); same, but 20 April [no year given], 1♂, 2♀ (MCZ).

Brachycentrus lateralis (Say): The species is known from scattered records from southeastern Canada south to South Carolina and as far west as Illinois. The Virginia records are from the northern Piedmont and montane provinces. Bath, Clarke, Fauquier, Floyd cos., Apr - May.

Brachycentrus nigrosoma (Banks): The distribution of this species is along the eastern side of the United States from Maine to Georgia. In Virginia it primarily occurs in the upper Piedmont with isolated populations in the Alleghanian Province. T.L. [Arlington Co.,] Glencarlyn, 25 April [no year given, of its synonym *B. notabulus* Milne, MCZ]. Arlington, Craig, Fairfax, Fauquier, Hanover, Isle of Wight, Loudoun, Spotsylvania cos., Apr - May.

Brachycentrus numerosus (Say): The species is widely distributed from central Manitoba south to Oklahoma and east to the Atlantic seaboard. In Virginia its distribution is spotty, but virtually covers the state west of the Fall Line. Carroll, Culpeper, Fauquier, Grayson, Hanover, Henrico, Louisa, Montgomery cos., Apr.

Brachycentrus solomoni Flint: This species and *B. appalachia* have nearly the same distribution, down through the Appalachians from southern Canada, but *B. solomoni* is only found as far south as central Virginia. In the state it has only been taken at a few sites in a small area of the central Alleghanian Province. Alleghany Co., Potts Creek, 3 mi SW Jordan Mines, 18 April 1980, many ♂ & ♀ (ROM). Bath Co., Jackson River, Hidden Valley bridge, 19 April 1980, 16♂, 1♀ (VPISU, NMNH); Blowing Springs Campground, 17 April 1968, 3♂, 8♀ (ROM). Craig Co., Potts Creek, Steel Bridge Campground, Rt. 18, 22 April 1979, 3♂, 4♀ (VPISU).

Brachycentrus spinae Ross: This is a species of southeastern United States, known from northern Georgia to central Virginia, where the few known localities are confined to the southern Blue Ridge Province. Amherst Co., Otter River, 10 September 1975, 1 larva (VPISU). Patrick Co., Rock Castle Creek, 15 March 1974, 1 larva, 1 pupa (VPISU). Washington Co., Laurel Creek, along US 58 ca. 2 mi E Damascus, 30 April 1994, ca. 50 ♂ & ♀ (VMNH).

Genus *Micrasema*

This is the largest genus in the family with approximately 50 species worldwide. It is also the most widely distributed, being found throughout the Northern Hemisphere from the Arctic into southeastern Asia as far as Borneo. The Virginia distributions cited herein include unpublished larval and adult records from Chapin (1978).

Micrasema bennetti Ross: This is a species of eastern United States, with reports from northern Georgia to Kentucky and Virginia. In Virginia it is recorded from the Piedmont and westward in the Alleghanian Provinces. Craig, Fauquier, Hanover, Tazewell cos., Apr - May.

Micrasema burksi Ross & Unzicker: A species of restricted distribution in eastern United States, *M. burksi* is known from northern Georgia to central New York. The few Virginia localities are all in the Blue Ridge Province. Page Co., stream crossing Skyline Drive just S Naked Creek overlook, Shenandoah National Park, 8 May 1960, 27 pupae (ROM). Rockingham Co., Dry Run Falls, Shenandoah National Park, 26 May 1975, 11♂, 1♀ (NMNH). Smyth Co., Hurricane Creek, at Hurricane Campground, 16 May 2004, 1♂ (NMNH). [Precise locality unspecified], Shenandoah National Park, 19 April 1968, larvae & pupae (ROM).

Micrasema charonis Banks: Another species of eastern North America, this one is more widely distributed than any of the foregoing. It has been recorded from Newfoundland south to Alabama, and is known in Virginia primarily from the Blue Ridge and Alleghanian provinces. Bath, Grayson, Hanover, Lee, Rockbridge, Rockingham, Smyth, Washington cos., Apr - Jun.

Micrasema rusticum (Hagen): This species is very widely distributed in eastern North America from southern Canada south to Alabama and west to eastern Saskatchewan and Arkansas. In Virginia it is known from the Piedmont west to the Alleghanies. Appomattox, Augusta, Brunswick, Carroll, Dinwiddie, Giles, Hanover, Lee, Lunenburg, Montgomery, Rockbridge, Wythe cos., Apr - Oct.

Micrasema scotti Ross: This species has a rather restricted distribution in eastern United States from Virginia west to Indiana and Tennessee. The Virginia localities are all in the Alleghanian Province. Alleghany, Bath, Craig, Giles, Highland, Montgomery, Smyth, Tazewell, Wythe cos., Mar - Aug.

Micrasema sprulesi Ross: Another species limited to the Appalachian Mountains of eastern North

America, it occurs from southern Canada south to South Carolina. The few Virginia records are in the Alleghanian Province. Giles Co., spring stream along headwaters of Johns Creek, off Rt. 632, 20 May 1979, 1♂ (VPISU). Rockbridge Co., Guys Run off Rt. 39, Bratton Mountain, 3 May 1978, 2♂ (VPISU); same data, but 19 May 1978, 5♂ (VPISU); Guys Run, 5 km off Rt. 39, 6 June 1978, 1♂ (VPISU).

Micrasema wataga Ross: This is the most common species of the genus found in eastern North America. It is known from southern Canada south to Louisiana and west to Oklahoma and Saskatchewan. In Virginia, it has been taken from the Fall Line to the western border of the state. Bath, Caroline, Carroll, Craig, Culpeper, Dickenson, Fauquier, Floyd, Franklin, Giles, Grayson, Hanover, Henry, Louisa, Montgomery, Patrick, Pittsylvania, Pulaski, Rockbridge, Russell, Shenandoah, Smyth, Stafford, Washington cos., Apr - Sep.

Family Calamoceratidae

Genus *Anisocentropus*

This genus contains numerous species in Asia, especially the islands of Indonesia and Australia, with a few species in Africa and Madagascar. Only one species occurs in the New World, and it is found in Virginia.

Anisocentropus pyraloides (Walker): The species is limited to southeastern United States from Florida to Delaware, west to Mississippi. The Virginia records, both adult and larval, are primarily from the mountains and Piedmont. The adults are diurnal and rarely attracted to light traps. Botetourt, Chesterfield, Craig, Goochland, Louisa, Patrick, Prince William, Shenandoah, Sussex cos., May - Jul.

Genus *Heteroplectron*

The genus contains only two species, one distributed along the East Coast of North America, the other along the West Coast.

Heteroplectron americanum (Walker): It is distributed from Alabama to southern Quebec mostly in the coastal states. The few Virginia records are scattered across the state from the Coastal Plain to the western border. Carroll, Essex, Fauquier, Floyd, Franklin, Lee, Patrick, Washington cos, May-June.

Family Goeridae

Genus *Goera*

Species of this genus are found in Europe, North America, and Asia, especially in Southeast Asia and offshore islands, reaching as far afield as Fiji. A species found in southern Africa may also be congeneric.

Goera calcarata Banks: This common species is widely distributed in eastern North America from southern Canada to Alabama and to just west of the Appalachians. It is found over most of Virginia, being absent from the Coastal Plain and lower Piedmont and high elevations. Amherst, Augusta, Bath, Bland, Botetourt, Campbell, Carroll, Craig, Culpeper, Fauquier, Floyd, Franklin, Giles, Grayson, Henry, Highland, Lee, Montgomery, Nelson, Patrick, Pittsylvania, Rappahannock, Rockbridge, Russell, Scott, Shenandoah, Smyth, Tazewell, Washington, Wythe cos., May - Sep.

Goera fuscula Banks: The species is found from southern Canada to Georgia, almost exclusively along the Appalachian Mountains. In contrast to *G. calcarata*, its flight season is limited to spring. Bedford, Fauquier, Franklin, Frederick (larva), Grayson, Page (larva), Patrick, Rappahannock, Smyth, Tazewell, Washington cos., Apr - Jun.

Goera stylata Ross: This is the northernmost species of the three congeners found in the state, known from southern Canada to Virginia, west to Wisconsin. In our state it is generally found at high elevation or in cold spring-fed streams from the Blue Ridge, west. Augusta, Bath, Botetourt, Giles, Highland, Lee, Madison, Montgomery, Rockbridge, Smyth, Tazewell cos., May - Jun.

Genus *Goerita*

This small genus of three species is limited to the Appalachians of eastern North America, from New York to North Carolina/Tennessee. The genus was revised, with descriptions of both adults and larvae, by Parker (1998).

Goerita betteni Ross: This is the most widely distributed species in the genus, being recorded from New York to Tennessee and west to Ohio. Our few records are from the Blue Ridge and Alleghanian provinces. Bath Co., wet rock face/spring, Richardson Gorge, Rt. 603, 0.5 mi downstream from Blowing Spring Rod & Gun Club, 20 May 2002, 10♂, 1♀, 29 larvae (DER). Dickenson Co., Breaks Interstate Park, Laurel Branch, 11 June 1979, 15♂, 1♀ (NMNH). Madison Co., Hogcamp Branch, Shenandoah National Park, 2250', 8 July 1973, 1♂, 1♀ (NMNH).

Goerita semata Ross: This species has a rather limited distribution in the Appalachian Mountains. It is known from North Carolina and Tennessee, with the one Virginia collection from the Blue Ridge. Patrick Co., Little Rock Castle Creek, Rt. 605 off Rt. 8, 13 May 1979, 2♂ (VPISU).

Family Helicopsychidae

Genus *Helicopsyche*

In addition to *Helicopsyche*, only a single monotypic genus from New Zealand is recognized in the family. *Helicopsyche* is a very large genus reported from all of the faunal regions of the world, but it is most diverse in the Tropics and on larger tropical islands. The larvae construct their cases from sand and silk in the form of a snail shell. Johanson (1998) in his phylogenetic analysis of the family recorded 176 described, extant species, and later (2002) redescribed and refigured 64 of the 72 New World species.

Helicopsyche borealis (Hagen): This species is very widely distributed in the New World, from southern Canada to at least Costa Rica, and from coast to coast. In Virginia it is abundant from the western Piedmont through the mountain counties, with several outliers along the Fall Line. Amherst, Augusta, Bath, Bedford, Bland, Campbell, Carroll, Clarke, Dickenson, Fairfax, Floyd, Giles, Hanover, Lee, Montgomery, Pittsylvania, Rockbridge, Rockingham, Russell, Scott, Shenandoah, Smyth, Spotsylvania, Tazewell, Warren, Washington, Wythe cos., May - Oct.

Family Lepidostomatidae

Genus *Lepidostoma*

This is a large genus found, as presently defined, in all of the major faunal realms of the world except Australia, although it gets as close as Java in Indonesia. In his latest generic review of the family, Weaver (2002) recognized 350 extant species. Weaver (1988) recognized 73 species in North America, and more have been described subsequently. The records cited herein include all of the adult records in Weaver (1988).

Lepidostoma americanum (Banks): This is primarily an eastern species, being recorded from southern Canada to Georgia, along the coastal states. The Virginia localities are in the upper Piedmont and Blue Ridge provinces. Fauquier, Floyd, Patrick, Rockbridge, Rockingham, Spotsylvania cos., and Falls Church City, Jun - Jul.

Lepidostoma bryanti (Banks): This is another predominantly eastern species, reported from Newfoundland to Georgia, and west to Minnesota. The species is only known from two regions in Virginia, one in the Blue Ridge Province, the other in the Alleghanian. Grayson Co., Fox Creek, 1.7 mi W Troutdale, 12 June 1979, 1♂ (NMNH). Patrick Co., confluence of Rock Castle Creek and Little Rock Castle Creek, off Rt. 8, Rt. 605, 31 May 1980, 4♂ (VPISU). Smyth Co., Big Laurel Creek, nr. Konnarock, Jefferson National Forest, 26-27 May 1979, 1♂ (VPISU). Tazewell Co., Burkes Garden, Station Spring, end of Rt. 666, 28 May 1992, 2♂, 4♀ (DER).

**Lepidostoma carrolli* Flint: This eastern species is recorded from Maine to South Carolina and west to Ohio. A fall-flying species, it is only known from the Coastal Plain in Virginia. Essex Co., 1 mi SE Dunnsville, 17 collections (all from Malaise traps) between 3 September and 19 November 1993-1996 (NMNH).

Lepidostoma griseum (Banks): This species is relatively common and widespread over eastern North America from southern Canada to Georgia and west to Wisconsin. The Virginia records are concentrated in the Piedmont and Blue Ridge provinces, with a few from the Alleghanian and one in the Coastal Plain. Bedford, Botetourt, Carroll, Craig, Essex, Floyd, Grayson, Highland, Madison, Montgomery, Page, Patrick, Prince William, Rappahannock, Shenandoah cos., Aug - Oct.

Lepidostoma latipenne (Banks): The records of this species are scattered along the Atlantic coastal states from southern Canada to Alabama. The Virginia records are from the Piedmont and Blue Ridge. Brunswick, Carroll, Charlotte, Giles, Page, Patrick, Rappahannock, Rockbridge cos., Jun - Sep.

Lepidostoma lydia Ross: Another Atlantic seaboard species, this one has been recorded from Newfoundland to Georgia. It is only found in small streams in the mountains of Virginia in the Blue Ridge and Alleghanian provinces. T.L. - [Greene Co.] Lydia, Va. 20 April 1938 (INHS). Amherst, Augusta, Franklin, Grayson, Greene, Highland, Madison, Pulaski, Rappahannock, Rockingham, Smyth cos., Apr - Jun.

Lepidostoma mitchelli Flint & Wiggins: The species has a relatively restricted range in the Appalachians of North Carolina, Tennessee, and Virginia. The one Virginia record, northernmost known for the species, is from high elevation in the southern Blue Ridge. Grayson Co., Whitetop Creek, Forest Service Rd. 89, 13 August 1979, 1♂, 1♀ (VPISU).

Lepidostoma modestum (Banks): Records of this species are scattered along the Appalachian Mountains from Quebec to South Carolina. In Virginia, it has been collected only along the Blue Ridge in spring. Grayson Co., Fox Creek, 1.7 mi W Troutdale, 12 June 1979, 1♂ (NMNH). Rappahannock Co., Piney River, Shenandoah National Park, 1100', 28 May 1977, 1♂ (NMNH). Smyth Co., Hurricane Creek, at Hurricane Campground, 12 June 2002, 1♀ (NMNH); Big Laurel Creek, FS 828, 23 May 2005, 1♂, 1♀ (NMNH).

Lepidostoma ontario Ross: This, another eastern species, is taken in the mountains from Newfoundland to South Carolina. One of the Virginia localities is in the Blue Ridge, the other in the Alleghanian Province. Augusta Co., E side Great North Mountain, W Craigsville, 15 May 2000, 1♂ (NMNH); same, but 11 June 2001, 1♂ (WVU). Carroll Co.: Big Laurel Creek, Blue Ridge Parkway at Milepost 187.6, 7-8 June 2006, 1♂ (BLRI). Madison Co., White Oak Canyon, Shenandoah National Park, 27 May 1962, 2♂ (NMNH).

Lepidostoma pictile (Banks): The distribution of this species basically follows the mountains from Newfoundland to North Carolina. In Virginia it has been taken primarily in the Alleghanian Province. Augusta, Bath, Giles, Grayson, Montgomery, Rockbridge, Smyth cos., Apr - Jun.

Lepidostoma serratum Flint & Wiggins: This species is infrequently taken from Connecticut to Louisiana. It has been found in a small mountain stream (Moulton, 2007) and a spring run in the Blue Ridge. Grayson Co., spring run off Rt. 604, ca. 5.5 mi W Reavistown, 36°37.095' N, 81°02.448' W, 15 September 2005, 3♂ (UT). Patrick Co., Little Rock Castle Creek, 3 mi W Woolwine, 11 September 1996, 1♂, 1♀ (VMNH).

Lepidostoma sommermanae Ross: The species has been taken from southern Canada south to Virginia and west to Indiana. In Virginia it is known primarily from the Blue Ridge. Fairfax, Floyd, Giles, Grayson, Greene, Madison, Page, Patrick, Rappahannock, Smyth cos., and Galax City, May - Sep.

Lepidostoma tibiale (Carpenter): This is a species of the southeastern mountains from Alabama to Virginia, with Giles County representing the northernmost known limits. The three Coastal Plain sites are notably disjunct from the main part of the species' range in the state (Hoffman & Parker, 1997a). Bland, Carroll, Giles, Grayson, Greensville, Hanover, Montgomery, Nelson, Pulaski, Southampton cos., May - Oct.

Lepidostoma togatum (Hagen): This is the most widespread species of the genus in North America, being recorded from the Northwest Territories and Alberta, south to Arkansas and east to Newfoundland and Alabama. It is generally taken near larger rivers in Virginia from the Piedmont to the Alleghanies. Bath, Botetourt, Campbell, Carroll, Clarke, Fairfax, Floyd, Giles, Grayson, Hanover, Loudoun, Montgomery, Patrick, Pittsylvania, Pulaski, Shenandoah, Sussex, Warren, Washington, Wythe cos., and Radford City, May - Oct.

Lepidostoma vernale (Banks): The species is known from Newfoundland south to Virginia and west to Michigan. In Virginia it appears to be limited to the Blue Ridge and upper Piedmont. Fairfax, Fauquier, Madison, Patrick, Rappahannock cos., May.

Genus *Theliopsyche*

This is a small genus of six described species, all limited to the Appalachian Mountains, primarily in the southern half. They appear to breed in small spring runs.

Theliopsyche grisea (Hagen): This is a species of the Appalachian Mountains, known from New Hampshire to South Carolina. The only Virginia records are from the Blue Ridge and Alleghanian Provinces. Giles Co., spring seep and roadside ditch, Forest Service Rd. 734, 5 mi from Rt. 804, 16 July 1978, 1♂ (VPISU). Rockbridge Co., Beckney Hollow, bank vegetation, 27 June 1978, 1♂ (VPISU). Smyth Co., unnamed stream, N side White Top Mountain, Rt. 600, 10 August 1980, UV, 1♂ (CUAC).

Theliopsyche melas Edwards: The species had been known for certainty from Kentucky and Tennessee. This unique Virginia record is from the Alleghanian region. Giles Co., Big Stony Creek, 13 July 1977, BLT, 1♂ (VPISU).

Family Leptoceridae

Genus *Ceraclea*

This is a large genus of about 120 species placed in several subgenera. It is distributed around the Northern Hemisphere and south into southeastern Asia and Africa. In the New World about 35 species have been recorded. The larvae live in all sorts of aquatic habitats from small, cold streams to large rivers and lakes. They generally feed on detritus, but some are known to feed on freshwater sponges or snails.

Ceraclea ancyla (Vorhies): This species is widely distributed over eastern North America from Quebec to Alabama and west to North Dakota and Kansas. The five known Virginia localities are in the Piedmont and southern Alleghanies. Carroll, Culpeper, Pittsylvania, Russell, Smyth cos., May - Aug.

Ceraclea cancellata (Betten): This is a widespread and common eastern species, mostly east of the 100th Meridian, but reaching British Columbia in Canada and Montana in the United States. In spite of the recent recognition of a cryptic species, *C. enodis,* there is still a good deal of variation in the genitalia of both of these forms, suggesting that more cryptic species may yet be recognized. In Virginia it has been taken from the upper Coastal Plain west through the Alleghanian Highlands. All of the following records have been rechecked to verify their identity. Bath, Carroll, Giles, Grayson, Greensville, Hanover, Henry, Lee, Louisa, Montgomery, Shenandoah, Smyth, Sussex, Washington, Wythe cos., and Radford and Richmond cities, May - Sep.

Ceraclea diluta (Hagen): This is another widespread eastern species known from Newfoundland to Alabama and west to Manitoba and Kansas. In Virginia the records are rather erratic: most are from the Coastal Plain with two in the Alleghanies, skipping the Piedmont. Bath, Caroline, Giles, Greensville, Hanover, Middlesex, Sussex cos., May.

Ceraclea enodis Whitlock & Morse: This species was described only in the mid-1990s. It is very closely related to *C. cancellata*, distinguished by subtle differences in the male genitalia, and by its larvae being thought to feed on the freshwater sponge, *Anheteromeyenia ryderi* Potts. The material listed below agrees in the genitalic structures, but the larval food preferences are unknown. However, its abundance and widespread distribution from the Coastal Plain to the Alleghanies in Virginia suggest that sponge feeding may be only facultative and not obligatory. Botetourt, Carroll, Culpeper, Fairfax, Floyd, Franklin, Giles Greensville, Halifax, Hanover, Isle of Wight, Loudoun, Louisa, Montgomery, Pittsylvania, Sussex, Warren cos., and Radford and Suffolk cities, May -Aug.

Ceraclea flava (Banks): The known distribution of this species extends from Ontario to Alabama, west to Minnesota and Texas. In Virginia, it has been taken primarily in the Coastal Plain and Piedmont with a few records into the Blue Ridge. Lectotype locality - Falls Church [MCZ, no further data]. Amherst, Carroll, Culpeper, Fairfax, Hanover, Louisa, Middlesex, Nelson, Spotsylvania cos., and Falls Church and Suffolk cities, Jun-Jul.

Ceraclea maculata (Banks): This is perhaps the most widespread species of the genus, having been recorded from coast to coast but absent from the Southwest and southern Rockies. In Virginia it is equally widespread from the Coastal Plain to the western border. Campbell, Caroline, Craig, Fairfax, Giles, Greensville, Hanover, King & Queen, Lancaster, Lee, Middlesex, Montgomery, Northumberland, Pittsylvania, Rockbridge, Southampton, Wise cos., and Chesapeake and Suffolk cities, May - Aug.

Ceraclea neffi (Resh): The species was described from the Piedmont of Virginia, and is still only known from a few more localities from the Piedmont to the Alleghanies. Otherwise it has been reported from Virginia south to Alabama and west to Kansas and Minnesota. T.L. - Fauquier Co., Broad Run, Thoroughfare Gap, Bull Run Mountains, larva 9 May 1972, emerged 24 June 1972 (INHS). Grayson Co., New River, bridge above Fries, 25 July 1975, 1♂ (VPISU). Montgomery Co., Hoot Owl Barn, VPI campus, 9 July 1976, 1♂ (VPISU). Radford [City], 24-30 June 1977, 1♂ (VPISU).

Ceraclea nepha Ross: The species has a rather wide distribution in eastern North America from Delaware to

Alabama and west to Minnesota and Oklahoma. The Virginia records are from the Coastal Plain and lower Piedmont. Dinwiddie, Greensville, Isle of Wight, King & Queen, Middlesex, Southampton, Surry, Sussex, Westmoreland cos., May - Aug.

Ceraclea ophioderus (Ross): This species has a restricted distribution from Virginia to Alabama and west to the Mississippi River. The Virginia localities are from the Coastal Plain and Piedmont. Brunswick, Dinwiddie, Greensville, Halifax, Isle of Wight cos., Jun - Aug.

Ceraclea protonepha Morse & Ross: The species has a distribution almost identical to *C. nepha*: Delaware to Florida, west to Kansas. The Virginia localities are limited to the Coastal Plain. OSF has taken this species always mixed with *nepha*, leading to the question of whether it is anything more than a variant. T.L. - Norfolk Co. [now Chesapeake City], along north edge of Lake Drummond, Dismal Swamp, 18 May 1963 (INHS). Dinwiddie, Greensville, Isle of Wight, King & Queen, Middlesex, Northumberland, Southampton, Surry, Sussex, Westmoreland cos., and Chesapeake City, May - Jun.

Ceraclea punctata (Banks): The records of this species range from Quebec to Virginia, and west to Wisconsin and Kansas. The Virginia records are on the Fall Line, separating the Coastal Plain from the Piedmont. Hanover Co., South Anna River, Rt. 657, 13 September 1977, 1♂ (VPISU). Louisa Co., South Anna River, Rt. 522, 19 July 1977, 1♂ (VPISU).

**Ceraclea resurgens* (Walker): The sole previous Virginia record of the species is a dot in Harris et al. (1991) in the outline of the state. S. C. Harris (pers. comm.) does not know the source of this record; it is possibly a *lapsus* occurring during preparation of the map. The species has recently been taken on the banks of the Potomac River in spring, finally verifying its occurrence in the state. Fairfax Co., Turkey Run Park, parking lot C-1, 38°57.9' N, 77°09.2' W, 5 May 2007, light trap, 1♂ (NMNH); same, but 19 May 2007, 1♂, 1♀ (NMNH); Fairfax Co., Great Falls Park, toilet area, 38°59.5' N, 77°15.2' W, 12 May 2007, 13♂, 8♀ (NMNH, GWMP); same, but quarry, 38°59.1' N, 77°14.8' W, 10-17 May 2007, Malaise trap, 1♂ (NMNH).

**Ceraclea ruthae* (Flint): This species is restricted to northeastern North America from Newfoundland to Virginia. The record from North Carolina in Etnier et al. (1998) pertains to an undescribed species (J. C. Morse, pers. comm.), and the locality attributed to Virginia by Carnagey & Morse (2006) is, in fact, in Vermont. The single known Virginia record is in the Alleghanies, well to the south of the closest other records in northeastern and northwestern Pennsylvania. Highland Co., calcareous seepage swamp beside US 220, 2 km S Mustoe, 30 July 2003, 1♂ (VMNH).

Ceraclea slossonae (Banks): This is a widespread species of North America, from Quebec to Florida, primarily along the eastern seaboard, but also as far west as Mississippi. Most Virginia records are from the Piedmont, with a few from the Alleghanies. Bath, Campbell, Carroll, Culpeper, Grayson, Greensville, Hanover, Pittsylvania cos., Jun - Aug.

**Ceraclea spongillovorax* Resh: This seldom-collected species ranges from the Potomac River, MD/VA to Florida and west to Illinois and Kansas. In addition to the Piedmont site recorded below, larvae were taken in the Potomac River (all in Maryland) bordering Loudoun and Fairfax counties, Virginia, also in the Piedmont. Dinwiddie Co., Fort Pickett, jct. Lake and Pelham Roads, 2 August 1995, 3♂, 3♀ (VMNH).

Ceraclea tarsipunctata (Vorhies): This very widespread, abundant species, has been taken from coast to coast and from southern Canada to the Gulf, but seems to be missing from the Rocky Mountain region. It is equally widespread through all faunal provinces in Virginia. Accomack, Brunswick, Caroline, Charlotte, Craig, Culpeper, Dickenson, Dinwiddie, Essex, Fairfax, Fluvanna, Franklin, Giles, Greensville, Halifax, Hanover, Henry, Isle of Wight, Louisa, Mecklenburg, Montgomery, Northumberland, Pittsylvania, Prince Edward, Smyth, Southampton, Sussex, Washington cos., and Radford and Suffolk cities, May - Aug.

Ceraclea transversa (Hagen): Widespread in eastern North America from Newfoundland to Florida, it is found westward to the 100th Meridian and in the northern Great Plains to Montana and Saskatchewan. The Virginia records are scattered across the state from the Coastal Plain into the Alleghanies. Amherst, Augusta, Clarke, Dinwiddie, Giles, Greensville, Isle of Wight, King & Queen, Middlesex, Montgomery, Russell, Shenandoah, Smyth, Southampton, Sussex, Surry, Warren, Washington, Wythe cos., May - Sep.

**Ceraclea uvalo* (Ross): This species seems to have a restricted range in northeastern North America: Quebec to Virginia along the coastal states. In Virginia, it is here reported from the northern Piedmont, and additional material has been taken along the Potomac River in Maryland adjacent to Fairfax Co. Clarke Co., Shenandoah River, Rt. 621, 5.6 km N Rt. 50, 16 September 2002, 1♂, 1♀ (NMNH).

Genus *Leptocerus*

Only a single species of the genus is known from North America, although well over 100 species are described worldwide. The genus is especially diverse in Africa and Asia.

Leptocerus americanus (Banks): It is widespread in eastern North America from southern Canada to the Gulf Coast and west to the 100th Meridian. Considering its widespread distribution, surprisingly few collections have been made in Virginia, and all are from the Coastal Plain. The larval host plant, *Ceratophyllum*, is widespread in the state, making its limited distribution even more puzzling. [Fairfax Co.], Mount Vernon, 27 June 1915, 1♂, 1♀ (NMNH). James City Co., Colonial National Historical Parkway, Jamestown Island at edge of marsh, E Visitor Center, 12 June 2001, 1♀ (VMNH). Middlesex Co., Dragon Run, Rt. 603, 10 June 2005, 1♀ (NMNH). [City of Chesapeake], Lake Drummond, Dismal Swamp, 8-9 June 1974, 4♀ (NMNH).

Genus *Mystacides*

This is a rather small genus of some 19 species. Their center of diversity is in eastern Asia, but species are found throughout the Northern Hemisphere. Three species occur in North America, only one of which is known from Virginia.

Mystacides sepulchralis (Walker): This species is very widespread in North America from the Atlantic to the Pacific and north to the Arctic, but is generally unrecorded from the Great Plains to the west coast in the United States, except for a record from California. In Virginia it has been taken from the Piedmont west through the Alleghanies. Bath, Bland, Botetourt, Caroline, Charlotte, Clarke, Craig, Culpeper, Dinwiddie, Fairfax, Fauquier, Floyd, Franklin, Frederick, Giles, Halifax, Hanover, Henrico, Lee, Lunenburg, Mecklenburg, Montgomery, Rappahannock, Rockbridge, Russell, Scott, Smyth, Warren, Wythe cos., and Radford City, May - Sep.

Genus *Nectopsyche*

This is a fairly large genus of approximately 60 species, exclusively of New World distribution. Its center of diversity is in the Neotropics, but about 15 species occur north of Mexico. Only four of these species have been recorded from Virginia.

**Nectopsyche albida* (Walker): Due to great similarity in structure of the male genitalia, several species in the genus are hard to separate on this basis. Color pattern of the hairs on the forewing is useful, but the pattern is soon lost in alcohol. The material recorded below was listed as *N. diarina* by Parker & Voshell (1981). The separation of *N. albida, N. diarina* Ross, and *N. spiloma* Ross, which all have the same clasper form, is very difficult, and the color pattern is lost on most alcoholic specimens. The series is clearly not *N. spiloma* which has very large eyes. Based on eye size (cf. Ross, 1944, figs. 759-761), they are *N. albida*. What little remains of the color pattern on one specimen is in complete accord with the pattern on pinned specimens from Quebec and Pennsylvania.

N. albida is known to range from Quebec west to Saskatchewan and south to Missouri and Pennsylvania. It has only been taken at one locality in the Piedmont in Virginia, which however represents a new southern range extension for the species. Louisa Co., South Anna River, Rt. 522, 19 July 1977, 4♂ (VPISU).

Nectopsyche candida (Hagen): This species is widely distributed over eastern North America from southern Canada south to the Gulf coast and west to the 100th Meridian and Montana. The rather few Virginia records are from the upper Coastal Plain and the Piedmont. Charlotte, Culpeper, Dinwiddie, Fairfax, Franklin, Greensville, Hanover, Montgomery, Pittsylvania, Southampton cos., May - Aug.

Nectopsyche exquisita (Walker): This very pretty species has a recorded distribution agreeing with that of *N. candida*. However, it is much more widely distributed in Virginia, being known from the Piedmont to the western border. Brunswick, Campbell, Caroline, Carroll/Grayson, Clarke, Culpeper, Dinwiddie, Fairfax, Floyd, Franklin, Giles, Grayson, Greensville, Hanover, Henry, Lee, Louisa, Mecklenburg, Montgomery, Patrick, Pittsylvania, Russell, Shenandoah, Warren, Washington cos., and Radford City, Jun - Sep.

Nectopsyche pavida (Hagen): The recorded distribution of this species is, again, almost like that of

N. candida, except that it occurs no farther west than Minnesota, and it ranges into Mexico. If the very closely related *N. muhni* Navás is shown to be a synonym, it would then extend south throughout Central and South America to Argentina. In Virginia, it is primarily a species of the Coastal Plain and Piedmont, with records from the southwestern corner of the state, the range thus skipping over the Blue Ridge and Alleghanian provinces. Bedford, Brunswick, Charlotte, Dinwiddie, Fairfax, Greensville, King & Queen, Lancaster, Lee, Louisa, Middlesex, Pittsylvania, Scott, Southampton cos., and Chesapeake City, Jun - Sep.

Genus *Oecetis*

This is a huge genus containing several hundred species found in all faunal realms, including many oceanic islands. Approximately 20 species are known from north of Mexico, eight of which have been taken in Virginia. The data below include larval records from Floyd (1995).

Oecetis avara (Banks): The species is widespread across North America from the Atlantic to the Pacific, and southern Canada to the Gulf and South America. It is widespread in Virginia from the Piedmont to the western border. Amherst, Bath, Bedford, Botetourt, Campbell, Caroline, Carroll, Clarke, Culpeper, Fairfax, Fauquier, Giles, Hanover, Lee, Montgomery, Rockbridge, Russell, Scott, Shenandoah, Warren, Washington, Wythe cos. and Radford and Virginia Beach cities, Jun - Sep.

Oecetis cinerascens (Hagen): The species is widespread in the United States and southern Canada, primarily east of the 100th Meridian, but extending westward in Canada to Alberta and south into northeastern Mexico. It is equally widespread in Virginia from the Coastal Plain to the western border. Amherst, Bedford, Campbell, Carroll, Culpeper, Dickenson, Dinwiddie, Fairfax, Franklin, Greensville, Halifax, Hanover, Isle of Wight, King & Queen, Lancaster, Louisa, Mecklenburg, Middlesex, Northampton, Prince William, Richmond, Shenandoah, Surry, Sussex, Warren, Westmoreland cos., and the cities of Chesapeake, Roanoke, Suffolk, and Virginia Beach, May - Oct.

Oecetis ditissa Ross: This species is limited to southeastern United States, from south of the Great Lakes west to the 100th Meridian. In Virginia this is a species primarily of the Coastal Plain, with one record from the southwestern part of the state. Campbell, Greensville, Hanover, Henrico, Isle of Wight, Lee, Louisa, Mecklenburg, Pittsylvania, Richmond, Russell, Southampton cos., and Suffolk City, May - Aug.

Oecetis inconspicua (Walker): This is a very abundant species throughout the United States and Canada from coast to coast, and south into South America. It is equally widespread in Virginia from the Atlantic Ocean to the western border, collected from more counties (61) than any other caddisfly. Larval studies (Floyd 1995) indicate that this may be a complex of species without clear adult differences; if so, this might change the distributional pattern considerably. Accomack, Alleghany, Amherst, Augusta, Bedford, Brunswick, Campbell, Caroline, Carroll, Chesterfield, Clarke, Craig, Culpeper, Dickenson, Dinwiddie, Essex, Fairfax, Fauquier, Floyd, Franklin, Giles, Grayson, Greensville, Halifax, Hanover, Henrico, Henry, Isle of Wight, King & Queen, Lancaster, Lee, Louisa, Mecklenburg, Middlesex, Montgomery, Nelson, Northampton, Northumberland, Patrick, Pittsylvania, Prince George, Prince William, Pulaski, Richmond, Rockingham, Russell, Scott, Shenandoah, Smyth, Southampton, Spotsylvania, Stafford, Surry, Sussex, Tazewell, Warren, Washington, Westmoreland, Wise, Wythe, York cos., and the cities of Chesapeake, Norfolk, Radford, Roanoke, Suffolk, and Virginia Beach, May - Oct.

Oecetis nocturna Ross: This species has a distribution similar to its close relative, *O. ditissa*, except that it is found farther north into southern Canada. It is primarily a species of the Coastal Plain and the Piedmont with a few records from the Alleghanies. Brunswick, Campbell, Caroline, Carroll, Dinwiddie, Floyd, Giles, Greensville, Halifax, Hanover, Henrico, Isle of Wight, Louisa, Montgomery, Nelson, Northampton, Patrick, Pulaski, Rockbridge, Rockingham, Shenandoah, Southampton, Sussex, Warren cos., and Radford City, May - Sep.

Oecetis osteni Milne: This is a species found east of the 100th Meridian from southern Canada to the Gulf. It is a species of the Coastal Plain in Virginia. The species was listed from VA (Ross, 1944), but without specific locality; these are the first specific sites and dates. Greensville, Henrico, Lancaster, Lunenburg, Northumberland, Richmond, Southampton, Surry, Sussex, Westmoreland cos., and Chesapeake City, Jun - Oct.

Oecetis persimilis (Banks): Similar to the preceding species, this one is limited to eastern North America. However, it is widespread across Virginia. Amherst, Arlington, Bath, Bland, Brunswick, Campbell, Caroline, Carroll, Clarke, Culpeper, Dinwiddie, Fairfax, Franklin, Giles, Greensville, Hanover, King & Queen, Lancaster, Lee, Lunenburg, Middlesex, Montgomery, Northumberland, Page, Patrick, Pittsylvania, Richmond, Rockingham, Scott, Shenandoah, Smyth, Southampton, Sussex, Warren, Washington, Westmoreland, Wise, Wythe cos., and the cities of Radford, Richmond, and Roanoke, Jun - Oct.

Oecetis sphyra Ross: This is a species of the southeastern states from Virginia to Louisiana. Most Virginia localities are in the Piedmont. Brunswick, Campbell, Caroline, Dinwiddie, Franklin, Greensville, Halifax, Hanover, Louisa, Pittsylvania, Southampton cos., Jun - Sep.

Genus *Setodes*

The genus contains several hundred described species found in Europe, Africa, Asia, Australia, and North America, with its greatest diversity in Southeast Asia. Fewer than 10 species are known from North America, with only two taken in Virginia.

**Setodes guttatus* (Banks): This species is found along the eastern seaboard, from Quebec to Alabama. The single Virginia record is from the Alleghanian Region, where it occurred with many *S. incertus*. Botetourt Co., Craig Creek, Oriskany, 8 August 1998, 2♂, 4♀ (VMNH).

Setodes incertus (Walker): The species is widespread in eastern North America from southern Canada to Alabama primarily east of the Mississippi River, extending as far west as Minnesota in the north. In Virginia it has been taken from the Piedmont west through the Alleghanies. Bath, Bedford, Botetourt, Campbell, Carroll, Clarke, Fairfax, Floyd, Franklin, Giles, Lee, Montgomery, Patrick, Pittsylvania, Russell, Scott, Smyth, Warren, Washington, Wythe cos., Jun - Sep.

Genus *Triaenodes*

This is another large leptocerid genus with over 150 described species known from all faunal realms. As presently restricted, 23 species are known from North America, ten of which have now been taken in Virginia. The data include the larval records from Glover (1996); however, he informs us (in litt.) that the records from Greene Co. actually should be Page Co., and those listed as Page Co. were from Rockingham Co.

**Triaenodes abus* Ross: There are records of this species scattered over eastern North America from southern Canada to the Gulf and west toward the 100th Meridian. Apparently the species is limited to the Coastal Plain in Virginia. Essex, Greensville, King & Queen, Isle of Wight, Southampton cos., May - Aug.

**Triaenodes dipsius* Ross: This seldom-collected species is known from southern Canada to Alabama and west to the 100th Meridian. The sole Virginia record is from the western Alleghanies. Bland Co., near Burkes Garden, 13 August 1972, 1♀ (NMNH).

Triaenodes flavescens Banks: This is basically an eastern species, from southern Canada to Florida west to the 100th Meridian, but with an anomalous larval record from British Columbia. Virginia records extend from the Coastal Plain to the western border. Bedford, Carroll/Floyd, Clarke, Dinwiddie, Fairfax, Floyd, Giles, Greensville, Isle of Wight, Montgomery, Page, Pittsylvania, Prince William, Pulaski, Rockingham, Russell, Shenandoah, Spotsylvania, Tazewell, Warren cos., and Radford City, May - Oct.

Triaenodes ignitus (Walker): This eastern species occurs primarily east of the Mississippi, from southern Canada to the Gulf, with a westward extension into Oklahoma. It is widespread in Virginia from the Chesapeake Bay to the western border. Alleghany, Bedford, Brunswick, Campbell, Caroline, Craig, Dinwiddie, Fairfax, Fauquier, Franklin, Greensville, Hanover, Mecklenburg, Middlesex, Montgomery, Northumberland, Page, Patrick, Pittsylvania, Prince William, Richmond, Russell, Smyth, Westmoreland cos., and Radford City, Jun - Sep.

Triaenodes injustus (Hagen): This is another eastern species found west to the 100th Meridian, but in southern Canada it reaches the west coast and is also known from Oregon. It has been taken throughout Virginia from Tidewater to the western border. Earlier records of *T. connatus* are included herein, as it is now considered synonymous (Manuel, 2008). Amherst, Bath, Bedford, Carroll, Clarke, Dinwiddie, Fairfax, Fauquier, Floyd, Franklin, Grayson, Greensville, Henry, Isle of Wight, King & Queen, Lee, Louisa, Montgomery, Page, Rappahannock, Rockingham, Russell, Shenandoah, Warren, Washington, Wise, Wythe cos., and the cities of Radford, Suffolk, and Virginia Beach, Jun - Oct.

Triaenodes marginatus Sibley: This species is found east of the 100th Meridian from southern Canada to Alabama. The Virginia records are scattered across the state from the Chesapeake Bay to the western border. Augusta, Bath, Dinwiddie, Essex, Fairfax, Floyd, Henrico, King & Queen, Lancaster, Lee, Middlesex, Montgomery, Northumberland, Page, Smyth, Wise, York cos., May - Sep.

**Triaenodes ochraceus* Betten & Mosely: The distribution of this species is southern, from Delaware to Mississippi. It is found primarily on the Coastal Plain and lower Piedmont in Virginia. Fairfax, Greensville, King & Queen, Middlesex, Northumberland, Nottoway, Richmond, Southampton, Westmoreland cos., May - Jun.

Triaenodes pernus Ross: This is primarily a southeastern species with a few records from southern Quebec, south to the Gulf and west to Oklahoma and Texas. In Virginia it is most common on the Coastal Plain, but has been taken all the way to the southwestern corner of the state. Alleghany, Amherst, Bedford, Brunswick, Franklin, Greensville, King & Queen, Lancaster, Middlesex, Northumberland, Richmond, Rockingham, Scott, Smyth, Southampton, Washington cos., and Chesapeake City, May - Sep.

**Triaenodes taenia* Ross: This species has a very limited distribution in the southern Appalachians from Virginia to Alabama. One of the Virginia localities is from the northern Piedmont, the other four from the southwestern Blue Ridge. Fauquier Co., Catharpin Creek, Jackson Hollow, 25 July 1964, 2♀ (NMNH). Floyd Co., sedge meadow at jct US 221 and Rt. 762, 3 km W Willis, 17 June 2004, 1♂ (VMNH); same, but 22 June 2004, 1♂ (VMNH); confluence of streams feeding Mabry Millpond, Blue Ridge Parkway at Milepost 176.2, 19-20 July 2007, 1♂, 2♀ (BLRI). Patrick Co., Rock Castle Creek, 24 August 2006, 1♂, 1♀ (NMNH); Little Rock Castle Creek, upstream confluence with Rock Castle Creek, Blue Ridge Parkway, 18-19 July 2007, 1♂, 1♀ (BLRI).

**Triaenodes tardus* Milne: This transcontinental species is known from southern Canada to Florida, but is generally lacking from the Atlantic seaboard and the southwestern states. The few Virginia records are scattered across the state from the Coastal Plain to the western Alleghanies. Accomack, Culpeper, Fairfax, Middlesex, Scott, Washington cos., May - Oct.

Family Limnephilidae

Genus *Anabolia*

In common with most limnephilid genera, this one is exclusively Northern Hemisphere in distribution - Europe, Asia, and North America. It contains almost 20 species of which five are known from North America, all from the northern and eastern sides of the continent.

Anabolia apora Parker: This species was described from west-central Virginia, and is still known only from that area. It is one of the few caddisflies known only from Virginia. T.L. - Montgomery Co., Blacksburg, 14 July 1964 (NMNH). Grayson Co., 5 mi W Troutdale on Rt. 603, Fox Creek headwaters, 11 June 1979, 1♂ (NMNH, paratype). Washington Co., Beartree Campground, 18 July 1979, 1♂ (NMNH, paratype).

The following females differ somewhat from typical *A. consocia* and being from the area of *A. apora*, they are probably this species, but lacking firm associations of the sexes the identification must be considered tentative. Smyth Co., Rt. 603, 1.5 mi E Rt. 600, at lighted church, 18 September 1988, 1♀ (NMNH). Tazewell Co., Burkes Garden, 17 August 1987, 2230 hrs, 1♀ (VMNH).

Anabolia consocia (Walker): This transcontinental species is very closely related to the preceding. It is recorded from Alaska to Quebec and south to Colorado and Virginia (there is an unsubstantiated record from North Carolina). Highland Co., Jackson River, jct US 220 and Rt. 606, 8 August 1978, BLT, 1♂ (VPISU).

The following specimen differs slightly from the females listed under *A. apora* and agrees more closely with other females of *A. consocia.* However, its identity is not absolutely certain. Bath Co., 5 mi off Rt. 39 on Rt. 611, Little Back Creek, 11 September 1979, 1♀ (NMNH).

Genus *Frenesia*

This genus contains only two species, both limited to eastern North America. They are the last species of the year to be found on the wing in Virginia. They have been taken on warm days in midwinter with snow on the ground.

Frenesia difficile (Walker): This species is reported from Newfoundland south to Virginia but only as far west as Ohio. The few Virginia records are from the Piedmont and Alleghanian regions. Arlington, Carroll, Floyd, Highland, Patrick cos., Nov - Jan.

Frenesia missa (Milne): The range of this species is much the same as the preceding, but has not been reported north of Quebec, and it extends farther westward into Arkansas and North Dakota. The Virginia records are from the upper Coastal Plain into the Blue Ridge. Culpeper, Fairfax, Fauquier, Floyd, Rappahannock, Smyth cos., Nov - Jan.

Genus *Hydatophylax*

This is a small genus of about 15 species, distributed across the Northern Hemisphere. Four species are known from North America, one along the West Coast, another in Alaska, and two in the East of which one enters our area.

Hydatophylax argus (Harris): This large and attractively-colored species has a wide range in the east from Newfoundland to Alabama and as far west as Minnesota. In Virginia we have records from the Coastal Plain to the western border. Appomattox, Bath, Bedford, Carroll, Floyd, Giles, Halifax, Isle of Wight, Montgomery, Nelson, Pittsylvania, Prince Edward, Richmond, Smyth, Spotsylvania cos., May - Jun.

Genus *Ironoquia*

This is a small genus of six described species, one of which is European, the other five are North American. One of these is limited to Nebraska, but there are records for the other four in the state.

**Ironoquia kaskaskia* Ross: The species has been recorded from Delaware to Alabama and west to Illinois. The Virginia records are primarily in the Coastal Plain, reaching into the Piedmont, with one record from the far southwest. Essex, Henrico, Isle of Wight, Louisa, Prince George, Prince William, Scott cos., and Suffolk City, Sep - Nov.

**Ironoquia lyrata* (Ross): This seldom-collected species has been recorded from Quebec to Virginia and west to Wisconsin. The single known VA locality is at the western foot of the Blue Ridge. Shenandoah Co., Strasburg, 21 September 1980, 4♂, 1♀ (NMNH).

Ironoquia parvula (Banks): The species usually inhabits temporary pools in northeastern North America. It is recorded from New Brunswick south to Virginia and west to Ohio. Roeding & Smock (1989) recorded the species from Surry Co., Buzzards Branch of Otterdam Swamp Creek, July 1984 - June 1985, larvae (material not retained). Smock further states (in litt.) that he has found this species a few other times at other similar sites; more precise documentation is desired.

Ironoquia punctatissima (Walker): This is the most widespread of the North American species of the genus: Nova Scotia to Florida and west to Arkansas and Minnesota. The Virginia records extend from the Coastal Plain to the western border. Accomack, Bath, Bedford, Charlotte, Clarke, Craig, Dinwiddie, Essex, Fairfax, Fauquier, Giles, Greensville, Halifax, Highland, Isle of Wight, Louisa, Montgomery, Nelson, Patrick, Prince George, Prince William, Russell, Scott, Shenandoah, Smyth, Surry, Tazewell, Washington cos., and Virginia Beach City, Sep - Nov.

Genus *Limnephilus*

This is one of the largest genera of caddisflies, with over 150 described species. They are found throughout the Holarctic Realm with a southward extension in North America along the high mountains of Mexico and Central America to Costa Rica. Almost 100 species are known from North America, but only three extend as far south as Virginia.

Limnephilus indivisus (Walker): This species is transcontinental in Canada, but only extends as far west as Utah and as far south as Virginia in the United States. The known sites in VA are all in the Alleghanian Province. Bath Co., Brown’s Pond, ca. 2.5 mi N Fort Lewis, 18 September 1994, 1♀ (VMNH). Craig Co., Craig Creek, Rt. 613, 2.5 mi E Barbours Creek at shale barrens, 19 September 2000, 1♂ (VMNH). Montgomery Co., New River floodplain near McCoy Pond, many reared ♂ & ♀, larvae, March-April 1978 (VPISU). Russell Co., E of Mill Creek, 8 km WNW Lebanon, 11 September 1996, 1♂ (VMNH). Tazewell Co., Burkes Garden, Flatwoods site, 21 May 1988, 1♀ (VMNH); Burkes Garden, Station Spring, 18 May 2005, 1♂ (NMNH).

Limnephilus moestus Banks: The distribution of this species is almost the same as the previous:

transcontinental in Canada and as far west as Utah and south along the coast to North Carolina in the United States (Hoffman & Parker, 1997b). The species is known from two widely separated regions in Virginia: the Alleghanian Province and the lower Coastal Plain. Giles Co., North Fork Big Stony Creek, bogs off FS 10420, N Kire, 9 June 2004, 1♂ (VMNH). Isle of Wight Co., Blackwater Ecologic Preserve, ca. 4 mi S Zuni, 26 May 1995, 1♂ (VMNH). Chesapeake City, Lake Drummond, Dismal Swamp, 19 May 1963, 7♂ (INHS).

Limnephilus submonilifer Walker): This species has a distribution more restricted to the east, barely reaching the 100th Meridian, but extending south along the Atlantic to South Carolina (NMNH unpublished). Although most of the Virginia records are from the Coastal Plain and Piedmont, it does occur into the Alleghanies. Accomack, Arlington, Augusta, Bath, Clarke, Essex, Fairfax, Fauquier, Lancaster, Loudoun cos., and Norfolk and Virginia Beach cities, Apr - Oct.

Genus *Nemotaulius*

This is a rather small genus of Holarctic distribution, with most species in the east Palearctic area, but extending overall from Europe through North America. Only a single species is found in North America, but it does attain Virginia in the east.

Nemotaulius hostilis (Hagen): The species is transcontinental in the northern states and Canadian provinces, reaching as far south as Utah in the Rockies and Virginia in the east. It is only known from a single locality in the far western Alleghanies in Virginia (Roble & Flint, 2001). Highland Co., Buck Run Ponds, Locust Spring Recreation Area, 5 August 1999, 2♀ (VMNH); same, but 6 September 1976, 13 larvae (NMNH).

Genus *Platycentropus*

This small genus contains only three species, all limited to northeastern North America. In addition to the one species which is known from Virginia, it is possible that *P. amicus* (Hagen) might occur in the state as it is known from as far south as New Jersey.

Platycentropus radiatus (Say): This species is widespread in eastern North America from Newfoundland south to the Gulf coast, east of the Mississippi River, but extending westward in the northern Great Plains to North Dakota and Manitoba. It is also widespread in Virginia, having been taken from the Coastal Plain to the western border. Alleghany, Augusta, Bath, Craig, Dickenson, Essex, Floyd, Giles, Greensville, Halifax, Highland, Isle of Wight, King & Queen, Louisa, Middlesex, Montgomery, Nelson, Patrick, Pittsylvania, Sussex, Westmoreland, Wise cos., and the cities of Chesapeake, Richmond, and Suffolk, May - Sep.

Genus *Pseudostenophylax*

This is a rather large and very diverse genus of around 75 species, centered in eastern Asia. Three species are known from North America, one on the West Coast, the other two in the East.

Pseudostenophylax sparsus (Banks): The species is limited to the Northeast, from Newfoundland to Virginia and west to Wisconsin. In Virginia it has been taken mostly in the northern Blue Ridge in and near Shenandoah National Park. Giles, Greene, Madison, Page, Rappahannock cos., May - Aug.

Pseudostenophylax uniformis (Betten): The distribution of this species is similar to the preceding: Quebec to North Carolina and west to Minnesota. It has been taken from the upper Piedmont west through the Alleghanian Provinces. Amherst, Bath, Bedford, Carroll, Floyd, Giles, Grayson, Patrick, Smyth, Washington cos., May - Jul.

Genus *Pycnopsyche*

This is a moderate-sized genus of not quite 20 species that is limited to North America, principally in the East. All of the Virginia records in the unpublished thesis of J. Wojtowicz (1982) are included below.

**Pycnopsyche circularis* (Provancher): This species is limited to northeastern North America from Nova Scotia to Tennessee and west to Wisconsin. The few Virginia records are from the Coastal Plain west into the Alleghanies. Augusta Co., Humpback Rocks Visitor Center, Blue Ridge Parkway, 16 September 1994, 1♂, 1♀ (VMNH). Bath Co., spring by Rt. 678, 0.75 mi N Fort Lewis, 23 June 2003, 1♂ (UT). Essex Co., 1 mi SE Dunnsville, 1-24 October 1994, 1♀ (NMNH); same, but 28 September-23 October 1995, 1♀ (NMNH). Giles Co., 4 mi NW Mountain Lake hotel, 2 September 1973, 1♂ (?VPISU). Louisa Co., 4 mi S Cuckoo, 7 October-4 November 1988, 1♂ (NMNH). Shenandoah Co., Strasburg, 21 September 1980, 2♂ (NMNH).

**Pycnopsyche conspersa* Banks: This species has a comparatively small range from Ontario to Virginia and Tennessee. The few known Virginia localities are all in the Alleghanian Province. It is the only *Pycnopsyche* species that commonly emerges in the spring. Bath Co., Gillets Run, 10 mi N Warm Springs, 17 July 1971, 1♂, 1♀ (NMNH); Blowing Springs Camp, 8 mi W Warm Springs, 18-20 May 1963, 1♂ (NMNH); same, but 10 September 1979, 1♂ (?VPISU); confluence of Cummings Run and Back Creek, 29-30 August 1973, 1♂ (?VPISU); spring at Rt. 678, 0.75 mi N Fort Lewis, 23 June 2002, 1♂ (UT). Highland Co., calcareous swamp beside US 220, 1.8 mi S Mustoe, 2350', 30-31 July 2003, 6♂, 4♀ (VMNH); 1 mi N Williamsville, Rt. 678, 3 May 1981, 1♂, 1♀ (?VPISU). Smyth Co., South Holston River at Rt. 670, Appalachian Trail foot bridge, W Sugar Grove, 13 June 1996, 1♂ (VMNH).

Pycnopsyche divergens (Walker): The species is recorded from Nova Scotia to North Carolina and west to Ohio. All of the Virginia records are from the Alleghanian and southern Blue Ridge provinces. Bath, Carroll, Grayson, Highland, Smyth, Tazewell, Wythe cos., Aug - Oct.

Pycnopsyche flavata (Banks): This species has one of the smallest ranges of any in the genus: Georgia to Virginia. All of the Virginia localities are in the southern Blue Ridge, with Rock Castle Creek in Patrick County apparently the northernmost. In addition to the usual fall flight season, this caddisfly frequently has been taken in the spring. Carroll, Floyd, Grayson, Patrick, Smyth, Washington cos., Jun - Sep.

Pycnopsyche gentilis (McLachlan): This species is widespread in the east from Newfoundland to Alabama and west to Ohio. It is also widespread in Virginia from the Fall Line to the western border with a single, disjunct, Coastal Plain record in Essex County. Amherst, Augusta, Bath, Bedford, Botetourt, Essex, Fairfax, Fauquier, Franklin, Giles, Greene, Grayson, Highland, Louisa, Madison, Montgomery, Nelson, Page, Patrick, Prince William, Rappahannock, Rockbridge, Rockingham, Smyth, Tazewell, Wythe cos., Jul - Oct.

Pycnopsyche guttifer (Walker): This is one of the more widely distributed species of the genus: Labrador to Florida, west to Colorado and Alberta. The Virginia records are scattered from the Piedmont through the Alleghanian Provinces. Bath, Craig, Fauquier, Floyd, Montgomery, Patrick, Prince William, Shenandoah, Smyth, Washington, Wythe cos., Sep - Oct.

Pycnopsyche indiana Ross: This species has been recorded from New York to Florida and west to Louisiana and Illinois. The Virginia records are mostly in the Piedmont, with one from the Alleghanies. The separation of this and *P. lepida* is often difficult and identifications could be erroneous, assuming the two species are distinct. Augusta, Bedford, Campbell, Dinwiddie, Greensville, Isle of Wight, Louisa cos., Sep - Oct.

Pycnopsyche lepida (Hagen): The species is widespread in eastern North America from Newfoundland to Alabama and west to the 100th Meridian. In Virginia records are scattered through the Alleghanies and northern Piedmont, with a disjunct site in the Coastal Plain. Amherst, Bath, Bedford, Craig, Fauquier, Floyd, Middlesex, Russell, Smyth, Tazewell, Washington cos., Sep.

Pycnopsyche luculenta (Betten): The species is widespread east of the Mississippi River, from southern Canada to Alabama. It is widespread in Virginia in small, fast-flowing, rocky streams from the Piedmont to the western border, with a single disjunct Coastal Plain site. Bedford, Botetourt, Carroll, Floyd, Franklin, Giles, Grayson, Highland, Louisa, Madison, Montgomery, Prince William, Rockbridge, Rockingham, Scott, Shenandoah, Smyth, Surry, Tazewell, Wythe cos., Aug - Oct.

**Pycnopsyche pani* Wojtowicz & Flint. This recently described species occurs almost exclusively in Virginia (Wojtowicz & Flint, 2007). One population is known from northern North Carolina, in addition to many in Virginia, all from localities in Blue Ridge and Alleghanian counties to the west. The type locality is Botetourt Co., McFalls Creek, Rt. 618, 19 September 1963 (NMNH). Amherst, Bath, Botetourt, Carroll, Giles, Floyd, Grayson, Madison, Page, Patrick, Smyth cos., Aug - Sep.

Pycnopsyche scabripennis (Rambur): This is a rather variable species as currently recognized and may represent a complex of species. In the broad sense (but recognizing *P. conspersa*), it is recorded from Newfoundland south to Florida and west to the Mississippi River. It is found in all regions of Virginia, including the Eastern Shore, but taken rather infrequently on the Coastal Plain. Accomack, Alleghany, Bath, Bedford, Botetourt, Carroll, Craig, Dinwiddie, Essex, Fairfax, Floyd, Giles, Grayson, Halifax, Highland, Isle of Wight, Lancaster, Lee, Louisa, Montgomery, Nelson, Patrick, Pittsylvania, Prince William, Rockbridge, Russell, Scott, Shenandoah, Smyth, Surry, Tazewell, Wythe cos., Jul - Nov.

**Pycnopsyche subfasciata* (Say): This is another widely distributed species in North America, being known from southern Canada south to Georgia and west to the 100th Meridian, although in the northern Great Plains it gets as far west as Colorado and Alberta. It has a spotty distribution in Virginia, generally being taken from larger rivers in the Piedmont. Appomattox, Botetourt, Campbell, Clarke, Fairfax, Lee, Rockingham, Shenandoah, Warren cos., Sep - Oct.

Pycnopsyche virginica (Banks): This is a rather scarce, rarely taken, and very distinctive species of *Pycnopsyche*. Its distribution is limited to Virginia south to Alabama and west to Tennessee (NMNH, unpublished). In Virginia it has been taken only on the Coastal Plain in the vicinity of small, spring-fed streams. T.L.–Richmond [City] [MCZ, no further data]. Essex, Greensville, Halifax, Isle of Wight, Louisa cos., and Richmond and Suffolk cities, Jun, Sep - Nov.

Family Molannidae

Genus *Molanna*

The genus *Molanna* is one of the Northern Hemisphere, and contains approximately 15 species, six of which are found in North America. Their larvae make very distinctive, flat cases of sand that have large lateral flanges.

Molanna blenda Sibley: This species is widespread in eastern North America from Newfoundland to Alabama and west to Arkansas and Minnesota. It is widespread in Virginia, being recorded in general from the Coastal Plain west through the Alleghanian Region. Amherst, Augusta, Bath, Bedford, Carroll, Essex, Fairfax, Fauquier, Floyd, Franklin, Giles, Greensville, King & Queen, Lee, Louisa, Madison, Nelson, Page, Patrick, Prince William, Rockbridge, Wise cos., May - Sep.

**Molanna tryphena* Betten: This species is limited to east of the Mississippi River from Quebec to Alabama. It is known from one drainage in Virginia, Dragon Run on the Coastal Plain. King & Queen Co., Dragon Run Swamp, Big Island, 22 May 2002, 3♂ (CSU). Middlesex Co., Dragon Run, Rt. 603, 16 September 2004, 1♀ (NMNH); same, but 10 June 2005, 5♀ (NMNH).

Molanna ulmerina Navás: This eastern species is generally found east of the Mississippi River, with an extension into Arkansas, from southern Canada to Florida. It is widespread in Virginia from the Coastal Plain into the Alleghanies. Bedford, Charlotte, Clarke, Fairfax, Grayson, Isle of Wight, Montgomery, Patrick, Rockingham, Russell, Shenandoah, Southampton, Spotsylvania, Sussex, Warren cos., May - Sep.

Molanna uniophila Vorhies: This species has a somewhat more northerly distribution than the other Virginian *Molanna* species. It is recorded from Newfoundland south to North Carolina, west to Arkansas and Manitoba. It has only been taken in the Great Dismal Swamp area of Virginia. Chesapeake City, 7 mi SE Suffolk, Lake Drummond, 17 July 1964, 2♂, 14♀ (NMNH); same, but 6-7 July 1962, 13♂, 4♀ (NMNH); same, but 8-9 June 1974, 26♂, 7♀ (NMNH); same, but 31 August 1962, 1♂ (NMNH); same, but 27 September 1959, 1♂ (VPISU); Dismal Swamp, Feeder Ditch, 16 June 1973, 4♂, 7♀ (NMNH, VPISU). Suffolk City, Great Dismal Swamp National Wildlife Refuge, West Ditch, 16 May 1998, 2♂ (VMNH).

Family Odontoceridae

Genus *Psilotreta*

The genus *Psilotreta* is known from eastern North America and eastern Asia and includes about 25 species. Four of the six North American species are known from Virginia. Parker & Wiggins (1987) revised the genus, describing all stages of the North American species, and what was available of the Asian species. The Virginia records in this work are included below.

Psilotreta frontalis Banks: This species ranges along the Atlantic Coast from Quebec to northern Florida, mostly in the mountains. In Virginia it is found from the upper Piedmont through the Alleghanies. Bath, Bland, Carroll, Fairfax, Fauquier, Floyd, Franklin, Frederick, Giles, Grayson, Greene, Louisa, Patrick, Rockbridge, Smyth, Spotsylvania, Tazewell cos., May - Jun.

Psilotreta labida Ross: The range of this species is similar to the preceding, but it only extends into northern New England and south to northern Georgia. In Virginia it has been taken primarily from the Blue Ridge and west, with two anomalous records from the Coastal Plain and Piedmont. The Henrico Co., Curles Neck Bridge paratype has been reexamined (E. Dewalt, pers. comm.) and found to be correctly determined; either the specimen has been mislabeled or perhaps was floated down river on some debris. Augusta, Bath, Bedford, Bland, Craig, Giles, Goochland, Henrico, Highland, Madison, Montgomery, Nelson, Page, Patrick, Rappahannock, Rockbridge, Russell, Shenandoah, Smyth, Tazewell, Wythe cos., Mar - Jun, Aug.

Psilotreta rossi Wallace: This species has a range restricted to the mountains of North Carolina, Tennessee, Virginia, and West Virginia. It has only been taken in small spring runs in the Blue Ridge and Alleghanies in Virginia. Giles Co., spring seep, Forest Service Road 734, 5 mi from Rt. 804, off Rt. 635, nr. Interior, 15 July 1978, 1♂ (VPISU). Grayson Co., headwater tributaries of Lewis Fork, off Rt. 603, 20 June 1981, 4♂ (ROM); spring seep, bog along Forest Service Road 89, 13 August 1979, 1♂, 2♀ (VPISU). Shenandoah Co., springs, Little Sluice Mountain Trail, nr. Liberty Furnace, 21 July 1974, 1♂ (NMNH); same, but 27 October 1974, 4 larvae (NMNH).

Psilotreta rufa (Hagen): This species is known from upstate New York south and west to northern Georgia and Mississippi. Most Virginia records are from the Blue Ridge, with others scattered from the upper Piedmont into the Alleghanies. Albemarle, Augusta, Franklin, Greene, Rappahannock, Shenandoah, Tazewell cos., Apr - Jul.

Family Phryganeidae

Genus *Agrypnia*

The genus, and many of its species, is of Holarctic distribution. Of the 18 known species, 11 are found in North America, with four of these also known from Europe or Asia. Wiggins (1998) completely revised the entire family, describing all stages when known. All records, adult and larval, in this work for this and the other confamilial genera are included below.

Agrypnia vestita (Walker): The species is widespread in eastern North America from Hudson Bay south to Florida and west to the 100th Meridian, with scattered populations across the northern United States and Canada to the Pacific. It has been found across Virginia from the Delmarva Peninsula to the far southwest. Accomack, Augusta, Bath, Bedford, Brunswick, Chesterfield, Essex, Giles, Isle of Wight, Louisa, Montgomery, Northampton, Northumberland, Nottoway, Page, Prince William, Russell, Scott, Smyth, Southampton, Sussex, Westmoreland cos., and Suffolk and Virginia Beach cities, May - Oct.

Genus *Banksiola*

This genus of five species is exclusively North American in distribution. Although only one species has been taken in the state, it is quite possible that three more, *B. concatenata* (Walker), *B. crotchi* Banks, and *B. smithi* (Banks), may occur here on the Coastal Plain.

Banksiola dossuaria (Say): This species is found widely in eastern North America from Labrador south to northwestern South Carolina, and west to Minnesota. In Virginia it has been taken only from sites above 3000 feet (914 m) in the Alleghanian Province. Alleghany, Bath, Craig, Dickenson, Giles, Highland, Smyth, Wise cos., May - Jul.

Genus *Oligostomis*

Oligostomis is a genus of five species, one European, another Chinese, one Japanese and two eastern North American. One of these species has now been taken in Virginia, and the second, *O. ocelligera* (Walker), may eventually be found in a boggy area in the western part of the state.

**Oligostomis pardalis* (Walker): Records of this species are scattered across southern Canada and the northern United States from western Ontario to Newfoundland, with a few scattered collections in the Appalachian Mountains as far south as western North Carolina and eastern Tennessee. In addition to a single adult specimen, there are two larvae of the genus, probably this species, from nearby localities in the Alleghanian region of Virginia. Giles Co., bogs at head of North Fork Stony Creek, off FS 10420, N Kire, 10 June - 2 July 2004, 1♂ (VMNH); White Pine Lodge Reach, Little Stony [Creek], *Rhododendron* leaf packs, 19 July 1978, 1 small (1st or 2nd instar) larva (VPISU); same, but birch leaf packs, 16 August 1978, 1 larger larva (3rd or 4th instar) (VPISU).

Genus *Phryganea*

This is another genus found across northern Europe, Asia, and North America. Of the eight known species, two are common in North America. The second North American species, *P. cinerea* Walker, is found north of the range of our species.

Phryganea sayi Milne: The known range of this species is from southern Canada south to northern Alabama, and west to northern Texas and eastern North Dakota. It is most common on the Coastal Plain and Piedmont in Virginia, but scattered records exist from the far southwest of the state. Albemarle, Amherst, Augusta, Bedford, Brunswick, Campbell, Carroll, Charlotte, Dinwiddie, Essex, Fairfax, Floyd, Franklin, Greensville, Halifax, Hanover, Isle of Wight, Lancaster, Loudoun, Louisa, Mecklenburg, Montgomery, Nottoway, Northumberland, Patrick, Pittsylvania, Richmond, Russell, Stafford, Tazewell, Westmoreland, Wise, York cos., and Suffolk City, May - Sep.

Genus *Ptilostomis*

Ptilostomis is a rather small genus of four species, limited, primarily, to eastern North America. Three of the four species are known from Virginia, and the fourth, *P. angustipennis* (Hagen), is known from as close as southern New Jersey.

Ptilostomis ocellifera (Walker): This species is common in eastern North America, from Newfoundland south to the Gulf, west almost to the 100th Meridian, and with a western population from central California north to the Arctic Circle in Alaska. It has been taken across the entire state. Augusta, Bedford, Botetourt, Campbell, Carroll, Charlotte, Essex, Fairfax, Floyd, Giles, Highland, King William, Lancaster, Loudoun, Louisa, Montgomery, Nelson, Nottoway, Patrick, Pittsylvania, Prince William, Rockbridge, Rockingham, Scott, Stafford, Surry, Washington, Westmoreland, Wise cos., and the cities of Chesapeake, Falls Church, Franklin, and Suffolk, May - Aug.

Ptilostomis postica (Walker): This species has a range limited to the East, from southern Quebec to Florida, west to Oklahoma and Manitoba. In Virginia it is found in the Coastal Plain and Piedmont with a few records from the Alleghanies. Accomack, Arlington, Caroline, Dinwiddie, Essex, Greensville, Isle of Wight, King George, Loudoun, Louisa, Middlesex, Montgomery, Southampton, Sussex cos., and Norfolk and Suffolk cities, May - Oct.

Ptilostomis semifasciata (Say): The distribution of this species is transcontinental in Canada, but in the United States it is found north of the Virginia-North Carolina line west to CO, WY, and MT with a single record in central Texas. The few Virginia records are from the upper Piedmont and Alleghanian provinces. Augusta, Carroll, Giles, Montgomery, Pittsylvania cos., Jul - Aug.

Family Sericostomatidae

Genus *Agarodes*

This genus is found only in eastern North America. Some 12-15 species have been described, many of limited distribution in the southeastern states. Two species are known from the state, but two others, *A. crassicornis* (Walker) and *A. distinctus* Ulmer, may be found with more collecting.

Agarodes griseus Banks: This species is reported from Quebec south to Alabama and Georgia, but only in the coastal states. The Virginia records are from the Coastal Plain west to the Blue Ridge provinces. Carroll, Essex, Fairfax, Floyd, Franklin, Greensville, King & Queen, Patrick, Pittsylvania cos., May - Jun.

Agarodes libalis Ross: This is another coastal species recorded from Louisiana to Delaware. The two known Virginia localities are in the Coastal Plain. Some of the larvae from the Surry Co. site were reared to adulthood to confirm their identity (L. Smock, pers. comm.). Northumberland Co., Bush Mill Stream, Rt. 601, S. Heathsville, 14 June 2005, 5♂, 13♀ (NMNH). Surry Co., Buzzards Branch of Otterdam Swamp Creek, July 1984 - June 1985, larvae (material not retained).

Genus *Fattigia*

This is a monotypic genus found in the southeastern United States.

Fattigia pele (Ross): This species is found in the Appalachian Mountains from Georgia north into Virginia as far as Page and Rappahannock counties. Our records are all from the Blue Ridge except for a single capture site in the Alleghanies. Bedford, Carroll, Floyd, Giles, Grayson, Madison, Patrick, Rappahannock, Rockbridge, Smyth cos., May-Jul.

Family Uenoidae

Genus *Neophylax*

This genus is found in eastern Asia and across North America, with 22 of the 32 described species present in North America. The recent revision of the genus by Vineyard et al. (2005) treats the world fauna, fully describing the adults and larvae of the North American species. Their records from Virginia are included herein.

**Neophylax acutus* Vineyard & Wiggins: This species had previously been known only from eastern Tennessee and adjacent Alabama and Kentucky. The two localities for Virginia are in the far southwestern corner, close to the known range. Lee Co., Sims Spring Run, Rt. 662, 11.5 air km SW Jonesville, 17 October 2003, 2♀ (NMNH); Wallen Creek, Rt. 665, mile 2.1, 19 June 2007, 4 prepupae (UT, NMNH).

Neophylax aniqua Ross: This species ranges across southern Canada from the western Great Lakes to Newfoundland, and then south along the backbone of the Appalachians into North Carolina and Tennessee. In Virginia it is limited to the Alleghanian Province. Augusta, Bath, Giles, Highland, Rockingham, Wythe cos., Sep - Oct; larvae, Apr - Jul.

Neophylax concinnus McLachlan: This, the type species of the genus, is widely distributed in eastern North America, east of the 100th Meridian, from Minnesota to Maine and south to Arkansas and Alabama. The Virginia records are from the Blue Ridge and Alleghanian provinces. Augusta, Botetourt, Craig, Fairfax, Fauquier, Giles, Montgomery, Page, Pulaski, Rappahannock, Rockbridge, Smyth, Warren, Wythe cos., Sep - Oct.

Neophylax consimilis Betten: This species is fairly restricted in eastern North America to a narrow band from Nova Scotia south along the Appalachians to northern Georgia. It is found along the Blue Ridge and adjacent areas in Virginia. Botetourt, Carroll, Grayson, Highland, Nelson, Page, Rappahannock, Rockbridge, Smyth, Tazewell cos., Aug - Oct.

**Neophylax etnieri* Vineyard & Wiggins: Previously, *N. etnieri* has only been reported from northeastern Tennessee. The following two records extend its known range considerably to the northeast into the Alleghanian area of southwestern Virginia. Lee Co., Sims Spring Run, Rt.662, 11.5 air km SW Jonesville, 17 October 2003, 10♀ (NMNH); same, but 21 September 1995, ♂ & ♀ metamorphotypes (UT). Washington Co., Spring Creek, Rt. 611, 1.2 mi N I-81 exit 13, 9 April 2003, 9 larvae (UT).

Neophylax fuscus Banks: The scattered records of this species show a distribution almost as large as that of *N. concinnus*: eastern North America from Minnesota to Nova Scotia, south to Missouri and northern Alabama. The Virginia records are from the Blue Ridge west through the Alleghanies. In contrast to most species of the genus, it prefers larger, warmer, lowland streams in these regions. Fairfax, Giles, Highland, Montgomery, Page, Pulaski, Rappahannock, Wythe cos., Sep - Nov.

Neophylax mitchelli Carpenter: The distribution of this species is much like that of several other congeners: fairly broad across southern Canada and the northeastern states (from eastern Ontario to Nova Scotia) becoming more restricted to a narrow band along the eastern Appalachians, south to northern Georgia and Alabama. The Virginia records are mostly concentrated along the higher elevations of the Blue Ridge with the exception of one anomalous record from the margins of the Potomac River in Fairfax County. Albemarle, Carroll, Fairfax, Fauquier, Grayson, Greene, Henry, Madison, Rappahannock, Rockbridge, Rockingham, Smyth cos., Sep - Oct.

Neophylax oligius Ross: The distribution pattern of this species is generally similar to the preceding, but is broader and not so closely restricted to higher elevations. It is known from Minnesota to Newfoundland and south into Alabama. In Virginia it has been taken in the Piedmont and Blue Ridge. Arlington, Fairfax, Fauquier, Grayson, Hanover, Louisa, Prince William cos., Sep - Oct.

Neophylax ornatus Banks: This very attractive species is known from Newfoundland and southern Ontario, south to northern Alabama all along the eastern Appalachians. The few Virginia records are from the Blue Ridge, generally at higher elevations. Amherst, Grayson, Madison, Nelson, Patrick cos., Jul -Sep.

Neophylax stolus Ross: This is a species of restricted distribution. It is recorded from west-central Virginia and adjacent West Virginia and Pennsylvania. There is a single specimen from western Massachusetts in the NMNH. In Virginia it has been taken at lower elevations in the upper Piedmont west into the Alleghanian Province. T.L. - [Highland Co.], Monterey, 28 September 1938 (INHS). Alleghany, Bath, Bedford, Craig, Fauquier, Giles, Highland, Montgomery, Smyth, Wythe cos., Jul - Oct.

Neophylax toshioi Vineyard & Wiggins: This species, occurring in moderate-sized, warmer streams, has a very limited distribution in west-central Virginia. T.L. - Wythe Co., Reed Creek, 5.3 km N I-81, Rt. 680, 20 October 1984 (ROM). Russell Co., Mill Creek, 1.25 mi E Carbo, 11 September 1996, 2♂ (VMNH, NMNH); Weaver Creek at Artrip Road, 20 June 2007, 4 larvae (UT, NMNH). Smyth Co., Snider Branch, Rt. 689 & 617, 6 air km NE Marion, 15-16 October 2003, 4♂, 3♀ (NMNH); North Fork Holston River, Rt. 622, Nebo, 27 September 2005, 3♂, 11♀ (NMNH). Tazewell Co., west end Burkes Garden, Station Spring Creek (MBC ranch), 19 September 1987, 1♂, 1♀ (VMNH). Wythe Co., same data as holotype, but 10 October 1987, ♂, ♀ (ROM); same, but 28 October 2002, 1♀ (NMNH); same, but 29 September 2005, 1♀ (NMNH); Rt. 680, 0.5 road mile above I-81 exit 60, E Marion, 9 April 2003, prepupae (UT); Reed Creek, Rt. 11, 1.8 mi W Wytheville, 4 October 1967, 1♂, 2♀ metamorphotypes (ROM); Reed Creek, bridge on US 11, W Wytheville, 18 November 1974, 1♀ (VPISU).

**Neophylax wigginsi* Sykora & Weaver: This species has been recorded only from southwestern Pennsylvania and southeastern Ohio, south to southeastern Kentucky. These, the first records from Virginia, are from the higher Alleghanies. Augusta Co., Shenandoah Mountain, Forest Service Rt. 85, 1 mi S Briery Branch Overlook, 4000', northern hardwoods, 22 October 2001, 1♂ (VMNH). Bath Co., Warm Springs Mountain, 2 km SE Hot Springs, 20 September 1999, 1♂ (VMNH); Big Little Creek [sic., Little Back Creek?], Rt. 601, 4 mi W jct Rt. 39, 11 September 1979, 1♀ (VPISU). Scott Co., Glady Fork wetland, end of Forest Service 2575, Jefferson National Forest, 22 September 1993, 2♂ (VMNH, NMNH). Wise Co., High Knob Lake, Jefferson National Forest, 22 September 1993, 1♂, 1♀ (VMNH).

**Neophylax* n. sp.: This species, currently being studied and described, is only known from a few localities on larger rivers in the Piedmont of northern Virginia. Fairfax, Shenandoah, Warren cos., and Fredericksburg City, Oct.

CHANGES TO THE LIST OF TRICHOPTERA OF VIRGINIA, PART I

The following removal of one species from the total accounted in our previous listing (Flint et al., 2004) and the addition of four species recently collected in the state brings the total known fauna for the families of Annulipalpia and Spicipalpia to 206.

Culoptila cantha (Ross): This species was recorded on the basis of a single collection from Floyd Co. Blahnik & Holzenthal (2006) have recently revised the genus *Culoptila* and recognized the eastern material as a new species *C. plummerensis*. Thus *C. cantha* should be removed from the state list and *C. plummerensis* Blahnik & Holzenthal substituted. Additional collections have recently been made: Carroll Co., Big Reed Island Creek, US 221 & Rt. 672, 12 July 2006, 2♂, 50♀ (VMNH, NMNH). Floyd Co., Mabry Millpond, Blue Ridge Parkway at Milepost 176.2, 19-20 July 2007, 1♂, 2♀ (BLRI)

Cheumatopsyche burksi Ross: The single specimen upon which the Virginia record is based has been studied by D.A. Etnier and O.S. Flint, who agree it is not *C. burksi*. However, the genitalia are quite distorted and we cannot make them agree with any species. It is suggestive of a species near *C. harwoodi* but does not seem to be that species either. At this time it must be left unknown, and *C. burksi* removed from the Virginia list.

**Hydroptila remita* Blickle & Morse: This species is widespread along the Atlantic Coast from Maine to Florida and as far west as Arkansas. It has now been taken in the Coastal Plain of Virginia. Westmoreland Co., The Big Swamp, Rt. 623, W Montross, 38°06.2' N, 76°51.7' W, 20 September 2006, 1♂, 8♀ (NMNH).

**Cernotina calcea* Ross: This species is recorded from Virginia to Florida and west to Illinois, Missouri, Texas, and into Mexico and Nicaragua in Central America. The only Virginia record is from the Coastal Plain. City of Suffolk, South Quay Pine Barrens, Cherry Grove Landing, Blackwater River, 16 June 2003, 1♂ (VMNH).

**Polycentropus harpi* Moulton & Stewart: Fulfilling the prediction made in the previous report, this species now has been found in the state. We have not reexamined the old material determined as *P. cinereus*, but a newly collected specimen agrees in all genitalic details with *P. harpi*. The record is from the Alleghanian area. Smyth Co., North Fork Holston River, Rt. 622, Nebo, 36°56.6' N, 81°26.4' W, 12 July 2006, 1♂ (NMNH).

**Rhyacophila mainensis* Banks: This is a widespread, but rarely reported, species known from Newfoundland to Virginia and west to Michigan. The single Virginia record is from the western foothills of the Mount Rogers Highlands. Smyth Co., South Fork Holston River, Rt. 670 bridge, Quebec, 22 May 2005, 1♀ (NMNH).

SPECIES OF INTEGRIPALPIA REMOVED FROM THE STATE LIST

The following species of families covered in the foregoing list have been documented for Virginia in various published sources; they are now excluded as explained for each.

Apatania rossi (Morse): Recorded by Parker & Voshell (1981), this species is now considered a synonym of *A. incerta* (Flint, 2007).

Lepidostoma costale (Banks): Although Weaver (1988) listed this species from Virginia without detail, he now (Weaver in litt.) says that this was in error due to a misreading of Banks (1914).

Lepidostoma excavatum Flint & Wiggins: Parker & Voshell (1981) listed the species for Virginia, without locality. We were unable to find any specimen and its associated locality data in the VPISU collection. As the known distribution is in the southernmost Appalachians, we remove this name from the state list.

Lepidostoma swannanoa Ross: Recorded by Parker & Voshell (1981), this species has since been placed in synonymy with *L. pictile* (Banks) by Weaver (1988).

Ceraclea mentiea (Walker): The sole record of the species is a dot in Harris et al. (1991) in the outline of the state. S. C. Harris (pers. comm.) does not know the source of this data. It is generally found to the north of Virginia and should be removed from the state list until material is found.

Nectopsyche diarina Ross: Recorded by Parker & Voshell (1981), the record is a misidentification of *N. albida* (Walker) (see p. 11).

Oecetis ochracea (Curtis): The species was recorded from Virginia by Parker & Voshell (1981). There is no material in the VPISU collection, but a manuscript list of Parker records a larva from Carroll Co., New River, bridge between Galax and Fries, Rt. 721, taken in a drift net by J. Kennedy. The overall range of this Holarctic species is to the northwest of the state. Until the material can be found and verified or fresh material is taken, it seems best to remove the species from the state list.

Triaenodes connata Ross: Recorded by Parker & Voshell (1981), the species is now placed in synonymy with *T. injusta* (Hagen) (Manuel, 2008).

Pycnopsyche sonso Milne: Recorded by Parker & Voshell (1981), based on misidentification of the recently described *Pycnopsyche pani* (Wojtowicz & Flint, 2007) (see p. 17).

Molanna musetta Betten: Recorded by Parker & Voshell (1981), the species is now placed in synonymy with *M. ulmerina* Navas (Schuster, 1979), which species was also listed by Parker & Voshell (1981).

Neophylax nacatus Denning: Recorded by Parker & Voshell (1981), the species is now placed in synonymy with *Neophylax mitchelli* Carpenter (Vineyard et al., 2005).

Neophylax atlanta Ross: The lone Virginia record in Vineyard et al. (2005) is unquestionably erroneous; the cited material is not in the NMNH, as indicated, nor do the authors know where it might be. The known range of the species is limited to the southern end of the Appalachians from northern Alabama to western South Carolina. The recorded published data are: "Campbell Co., Lynchburg, fall 1937 (NMNH)."

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A Lichen Survey of Williamsburg, Virginia

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ABSTRACT

A survey of lichens was conducted for the Williamsburg, Virginia, area, resulting in a checklist of 141 species (in 60 genera), 52 of which are potential state records. Noteworthy collections include one globally rare species (*Parmotrema louisianae*), and several species found outside of their typical ranges (subtropical/tropical species: *Amandinea submontana*, *Haematomma persoonii*, *Leiorreuma explicans, Leiorreuma sericeum*, and *Parmotrema praesorediosum*; species disjunct from the north: *Xanthomendoza fallax*; western species: *Bacidia helicospora*, *Parmotrema austrosinense*, *Punctelia missouriensis*, and *Rinodina papillata*). The influence of unique microhabitats (e.g., calcareous ravines and historic brick walls) on the local lichen flora is discussed.

Key words: biodiversity, checklist, Coastal Plain, flora, lichen, survey, Virginia, Williamsburg.

INTRODUCTION

Despite its diversity of lichen habitats and historical age as a city, few lichen collectors have conducted fieldwork in the Williamsburg, Virginia, area. The only area close to Williamsburg in geography and vegetation in which lichen diversity has been surveyed is the Eastern Shore of Maryland (Biechele, 2002; Lendemer & Knapp, 2007), which is located over 100 km to the northeast, bordering the state of Virginia. The present study reports the first lichen survey identified for any location in Virginia's Coastal Plain, and is based on an honors thesis by the primary author (Hodkinson, 2005). A considerable number of taxonomic additions and corrections have been made to the results reported in Hodkinson (2005), and are now included in this publication. Therefore, taxonomic citations should refer to this publication.

The study area is defined as the City of Williamsburg and its surroundings within 10 km of the city limits. Williamsburg (population approximately 12,000) is located in Virginia's Inner Coastal Plain, and is situated within the northernmost region of the southern mixed hardwood forest, representing varying degrees of age (DeWitt & Ware, 1979; Monette & Ware, 1983). Overall, the city receives more precipitation per year than any other city in Virginia (Bess, 2002). An interesting topographic feature of the area is the presence of deep-cutting ravines that extend down into the Yorktown and Eastover Formations. These formations are Pliocene in age, and are composed of marine and littoral deposits with sand, gravel, and clay (Bick & Coch, 1969; Dowsett & Wiggs, 1992). A high concentration of calcium carbonate, in conjunction with the cool and moist environment of the ravines, creates localized areas that support a vascular flora unlike the surrounding uplands (Ware & Ware, 1992). Many species inhabiting these ravines have predominant ranges that are further west and frequently mountainous. They have therefore been called "mountain-coastal plain disjuncts" (Ware & Ware, 1992; McDonald, 2000).

The buildings, walkways, and cultivated plants in the developed areas of Williamsburg also provide interesting substrates for the local lichen flora. For example, the College of William and Mary is cultivating many species of introduced and native trees, some of which have been shipped from distant locations. In addition, there are well-established communities of lichens living on the brick walls in Colonial Williamsburg. Many of the existing brick

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walls have been present for at least 70 years (pers. obs. from dated walls), but the continuous presence of such substrates in the town could potentially have hosted lichen metapopulations for over 300 years.

METHODS

The primary author collected lichens during excursions to local sites and between daily activities on the College of William and Mary campus during 2004 and spring of 2005. Collection efforts did not focus on any particular region within the study area, but instead attempted to maximize the diversity of potential substrates in order to maximize the species representation of the study. These substrates included roadsides, forested uplands, forested ravines, various tree species (both wild and cultivated), brick walls, concrete, sidewalks, and various soil types (e.g., acidic/basic, sand/clay, moist/dry). Although abundance was not quantified, each species was assigned to one of the following hierarchical categories by careful field observations:

Abundant – Present in nearly every location with a habitable substrate;
Common – Found in numerous locations, but not always present in suitable habitat;
Occasional – Found infrequently, but seen in at least two distinct locations;
Rare – A single specimen or extremely small population was found.

All species in the study are represented by herbarium specimen vouchers with full label data. Collection and preservation methods followed accepted archival protocols (May, 2000). Determinations were made throughout the collection period, and continued afterward at Duke University and the New York Botanical Garden. Researchers highly skilled in lichen identification assisted with the post-thesis determinations and verifications. The vast majority of this assistance came from Richard C. Harris; other researchers who examined specimens include Irwin M. Brodo, Jolanta Miadlikowska (*Peltigera*), Suzanne Joneson (*Ramalina*), Cécile Gueidan (*Verrucaria*), and François Lutzoni. Voucher specimens will be deposited in the Duke Cryptogamic Herbarium (DUKE), and a single specimen will be sent to the New York Botanical Garden (NY) for each species that was collected more than once. Label data for each specimen stored at DUKE will be available through the DUKE Catalog of Lichens (online at http://www.biology.duke.edu/herbarium/lichen.html).

RESULTS AND DISCUSSION

During this study, 141 species (in 60 genera) were identified and vouchered from the Williamsburg area. Of these species, 68 represent a crustose growth habit, 46 represent a foliose growth habit, and 27 represent a fruticose growth habit. Fifty-two species (36.8%) are apparently reported for the first time from the state of Virginia. The relatively high percentage of previously unreported species probably reflects the paucity of previous lichen surveys, but it may also reflect the area's potential for high lichen diversity. Some of this diversity can be attributed to the fact that the region is inhabited by species from both the typical Appalachian-Great Lakes and Coastal Plain distribution types (Brodo et al., 2001). Air quality also may play a role in the potentially high lichen diversity of the area. While many lichens are affected by air quality, cyanolichens are known to be especially sensitive to air pollution (Richardson & Cameron, 2004). A healthy environment is indicated by the presence of eight different cyanolichen species (*Collema bachmanianum*, *Leptogium cyanescens*, and six species in the genus *Peltigera*) in the study area.

Williamsburg contains two specific types of unique microhabitats (calcareous ravines and historic brick walls) that have clearly influenced the local flora. Similar to the patterns found for vascular plants, the forested calcareous ravines contained a lichen flora quite different from the surrounding areas. Several species were found exclusively in these ravine habitats, including *Anaptychia palmulata*, *Arthonia rubella*, *Bathelium carolinianum*, *Cladonia apodocarpa*, *C. beaumontii*, *C. caespiticia*, *C. didyma*, *C. ochrochlora*, *Leptogium cyanescens*, *Lobaria quercizans*, *Parmotrema gardneri*, *Peltigera horizontalis*, *P. neopolydactyla*, "*P. neopolydactyla* sensu lato," *P. phyllidiosa*, *P. praetextata*, *P. rufescens*, *Pertusaria multipunctoides*, *Phyllopsora corallina*, *Porina heterospora*, and *Pseudosagedia cestrensis*. A more detailed quantitative analysis of this phenomenon is provided by Wiseman (2006). A number of rock-inhabiting obligate calciphiles were also collected in the study area (e.g., *Bacidina egenula*, *Caloplaca citrina*, *Caloplaca subsoluta*, *Collema bachmanianum*, *Lecania cuprea*, *Lecanora dispersa*, and *Verrucaria calkinsiana*), but not on their typical limestone or dolomite outcrops. Since Williamsburg contains no outcrops, these species seem to be entirely dependent on manmade walls and sidewalks.

Particularly noteworthy collections include the globally rare *Parmotrema louisianae* and several species collected at the farthest reaches of their known ranges. A number of subtropical species at the northern edge of their ranges include *Amandinea submontana* (known from less than ten North American collections), *Haematomma persoonii* (the northernmost known except for an anomalous record from Pennsylvania), *Leiorreuma explicans*, *Leiorreuma sericeum*, and *Parmotrema praesorediosum*. Species that are typically found much farther west include *Bacidia helicospora* (only one other collection in the central Coastal Plain), *Parmotrema austrosinense*, *Punctelia missouriensis*, and *Rinodina papillata*. *Xanthomendoza fallax* appears to be disjunct from the north, since the nearest Coastal Plain record is from Connecticut. A final noteworthy collection is a seemingly undefined species that appears to be relatively common in the eastern United States (listed as "*Peltigera neopolydactyla* sensu lato"). The *Peltigera neopolydactyla* species complex will soon be revised, and this revision will almost certainly involve the description of a new species from the Williamsburg area (J. Miadlikowska, pers. comm.).

ANNOTATED CHECKLIST OF TAXA

The following list is arranged alphabetically by taxon name. Species listed as potential state records (*) are those for which no credible published report was found. In addition, observed abundance, preferred substrates, and the primary author's collection numbers are listed after each taxon. Specimens sent to the New York Botanical Garden are indicated by "NY".

Acarospora fuscata (Schrader) Arnold – Common; tops of brick walls; 2599

**Amandinea milliaria* (Tuck.) P. May & Sheard – Common; bark of deciduous trees; 1341, 2727 (NY)

Amandinea polyspora (Willey) E. Lay & P. May – Common; bark of deciduous trees; 335, 353 (NY)

Amandinea punctata (Hoffm.) Coppins & Scheid. – Common; bark of deciduous trees; 309, 1347 (NY), 3259

**Amandinea submontana* Marbach – Rare; bark of *Liquidambar styraciflua*; 3782

Anaptychia palmulata (Michx.) Vainio – Rare; bark in a calcareous ravine; 2317

Arthonia caesia (Flotow) Körber – Common; bark of various tree species; 367

**Arthonia quintaria* Nyl. – Common; bark of various tree species; 2191, 2456 (NY)

**Arthonia rubella* (Fée) Nyl. – Rare; bark of a deciduous tree in a calcareous ravine; 974

**Arthothelium taediosum* auct. Amer. – Rare; bark of *Ilex* sp.; 4171

**Bacidia coprodes* (Körber) Lettau – Occasional; mortar and concrete; 3274 (NY), 4020

**Bacidia helicospora* S. Ekman – Rare; bark of *Liquidambar styraciflua*; 3771

**Bacidia heterochroa* (Müll. Arg.) Zahlbr. – Rare; bark of *Prunus subhirtella*; 324

Bacidia schweinitzii (Fr. ex E. Michener) A. Schneider – Occasional; bark, especially of *Quercus* sp.; 1867 (NY), 2415

**Bacidia suffusa* (Fr.) A. Schneider – Rare; concrete; 1463

**Bacidina egenula* (Nyl.) Vězda – Rare; mortar; 1998

**Bathelium carolinianum* (Tuck.) R. C. Harris – Rare; bark in a calcareous ravine; 423

**Buellia curtisii* (Tuck.) Imshaug – Common; bark of deciduous trees; 303, 388, 1352 (NY)

Buellia stillingiana J. Steiner – Rare; bark of *Magnolia grandiflora*; 947

Caloplaca citrina (Hoffm.) Th. Fr. – Abundant; concrete and brick walls; 396, 1026 (NY)

Caloplaca flavovirescens (Wulfen) Dalla Torre & Sarnth. – Occasional; mortar on brick walls; 2331

**Caloplaca subsoluta* (Nyl.) Zahlbr. – Common; mortar on brick walls and sidewalks; 1023, 1024, 1025 (NY)

Candelaria concolor (Dickson) Stein – Common; bark of various tree species; 304 (NY), 1918

**Candelariella reflexa* (Nyl.) Lettau – Abundant; bark of various tree species; 88 (NY), 307, 805

Canoparmelia caroliniana (Nyl.) Elix & Hale – Occasional; tree bark; 830

Canoparmelia crozalsiana (de Lesd. ex Harm.) Elix & Hale – Occasional; bark of deciduous trees; 289, 525 (NY)

Canoparmelia texana (Tuck.) Elix & Hale – Abundant; bark of deciduous trees; 505 (NY), 2639

**Chrysothrix xanthina* (Vain.) Kalb – Occasional; tree bark; 3257

Cladonia apodocarpa Robbins – Occasional; sandy soil in calcareous ravines; 1946

Cladonia beaumontii (Tuck.) Vainio – Rare; soil in a calcareous ravine; 527

Cladonia caespiticia (Pers.) Flörke – Common; sandy soil in calcareous ravines; 1628 (NY), 2234

Cladonia cristatella Tuck. – Common; moist roadside soil and rotting wood; 87 (NY), 639, 1839

Cladonia didyma var. *vulcanica* (Zoll. & Moritzi) Vainio – Common; old wood and sandy soil in calcareous ravines; 1005, 2187 (NY)

Cladonia grayi G. Merr. *ex* Sandst. – Common; moist sandy soil on roadsides; 534 (NY), 653, 688

Cladonia macilenta var. *bacillaris* (Genth) Schaerer – Common; old wood; 610, 1300 (NY), 1324

Cladonia mateocyatha Robbins – Occasional; roadside soil; 529

Cladonia ochrochlora Flörke – Occasional; sandy soil in calcareous ravines; 2245, 2258 (NY)

Cladonia parasitica (Hoffm.) Hoffm. – Occasional; old wood; 1290

Cladonia peziziformis (With.) J. R. Laundon – Abundant; roadside soil, tops of brick walls, and sand between bricks on pathways; 425 (NY), 1283

Cladonia piedmontensis G. Merr. – Common; roadside soil; 644 (NY), 679

Cladonia polycarpoides Nyl. – Common; sandy soil; 646, 649 (NY), 1314, 2291 [chemotypes of *Cladonia subcariosa* are maintained as separate species in this list]

**Cladonia ramulosa* (With.) J. R. Laundon – Occasional; sandy soil; 484 (NY), 2080

**Cladonia ravenellii* Tuck. – Common; bark at the base of *Pinus taeda* and old pine wood; 566 (NY), 1536

Cladonia sobolescens Nyl. ex Vainio – Occasional; sandy soil; 561 [chemotypes of *Cladonia subcariosa* are maintained as separate species in this list]

Cladonia squamosa Hoffm. – Common; sandy soil; 728 (NY), 1322, 1489

Cladonia strepsilis (Ach.) Grognot – Occasional; roadside soil; 1323

Cladonia subradiata (Vainio) Sandst. – Occasional; untreated wood; 1775

Cladonia subtenuis (Abbayes) Mattick – Common; soil on roadsides and in calcareous ravines; 635 (NY), 1984, 2137

Cladonia subulata (L.) F. H. Wigg. – Common; mortar on brick walls; 492, 1739 (NY), 2077

**Collema bachmanianum* (Fink) Degel. – Common; mortar, concrete, and soil; 1364, 2098, 2355 (NY)

Dibaeis baeomyces (L. f.) Rambold & Hertel – Common; clay on roadsides and along the edges of paths around Lake Matoaka; 1770

Flavoparmelia baltimorensis (Gyeln. & Fóriss) Hale – Common; brick walls and bark; 1956 (NY), 2401

Flavoparmelia caperata (L.) Hale – Abundant; bark of all kinds and tops of brick walls; 721 (NY), 2287

Graphis scripta (L.) Ach. – Abundant; bark of all kinds; 831, 968 (NY), 1018

Haematomma persoonii (Fée) A. Massal. – Occasional; bark of *Ginkgo biloba* and cultivated *Pyrus* sp.; 1725, 2521, 2591 (NY)

**Heterodermia albicans* (Pers.) Swinscow & Krog – Common; brick walls; 475, 1107 (NY), 1789, 2173

Hyperphyscia syncolla (Tuck. ex Nyl.) Kalb – Occasional; tree bark in the open; 2063 (NY), 2352

Hypotrachyna livida (Taylor) Hale – Occasional; bark of *Acer rubrum*; 886, 901 (NY), 908

**Hypotrachyna showmanii* Hale – Occasional; top of brick walls; 478

**Lecania cuprea* (A. Massal.) v. d. Boom & Coppins – Rare; mortar; 562

Lecanora argentata (Ach.) Malme – Occasional; bark of *Fagus grandifolia*; 824 (NY), 827

Lecanora chlarotera Nyl. – Common; bark of deciduous trees; 312, 414, 3255 (NY), 3258, 3265

**Lecanora dispersa* (Pers.) Sommerf. – Abundant; brick walls and concrete; 1242

Lecanora hybocarpa (Tuck.) Brodo – Common; bark of deciduous trees; 361, 390, 392 (NY)

**Lecanora louisianae* de Lesd. – Common; bark of deciduous trees; 362 (NY), 412, 625

Lecanora strobilina (Sprengel) Kieffer – Abundant; bark and wood of all kinds; 807, 836, 906 (NY)

**Lecanora subpallens* Zahlbr. – Common; bark of deciduous trees; 910, 913, 1350 (NY), 1616

**Lecidea plebeja* Nyl. – Rare; old conifer wood; 383

**Leiorreuma explicans* (Fink) Lendemer – Rare; bark of a deciduous tree; 967

**Leiorreuma sericeum* (Eschw.) Staiger – Common; bark of deciduous trees; 565, 978 (NY)

**Lepraria caesiella* R. C. Harris – Rare; bark of a deciduous tree; 2281

Lepraria lobificans Nyl. – Abundant; brick walls and bark of all kinds; 1020

Leptogium cyanescens (Rabenh.) Körber – Abundant; bark of deciduous trees in calcareous ravines; 424 (NY), 1000

Lobaria quercizans Michx. – Rare; bark in a calcareous ravine; 1013

Loxospora pustulata (Brodo & Culb.) R. C. Harris – Common; bark of many tree species; 401, 1010, 1431 (NY)

Myelochroa aurulenta (Tuck.) Elix & Hale – Common; tops of brick walls; 473 (NY), 2434

**Nadvornikia sorediata* R. C. Harris – Occasional; bark of deciduous trees; 563

Ochrolechia africana Vainio – Common; bark of various tree species, shaded brick; 300 (NY), 301, 1945, 2010

**Opegrapha vulgata* Ach. – Common; bark of various tree species; 397, 2151 (NY)

**Parmotrema austrosinense* (Zahlbr.) Hale – Occasional; bark of cultivated *Buxus sempervirens*; 1937, 3262 (NY)

**Parmotrema gardneri* (C. W. Dodge) Sérus. – Occasional; bark in calcareous ravines; 846, 1017 (NY)

**Parmotrema hypoleucinum* (Steiner) Hale – Rare; bark of a cultivated deciduous tree; 1857

Parmotrema hypotropum (Nyl.) Hale – Common; bark of cultivated deciduous trees; 621 (NY), 1310, 1859

Parmotrema louisianae (Hale) Hale – Rare; bark of a branch overhanging Lake Matoaka (collected from a canoe); 1723, 1723B (NY)

Parmotrema perforatum (Jacq.) A. Massal. – Common; bark of cultivated deciduous trees; 711 (NY), 1910, 2134

**Parmotrema praesorediosum* (Nyl.) Hale – Rare; bark of cultivated *Pyrus* sp.; 1271

Parmotrema reticulatum (Taylor) M. Choisy – Occasional; top of a brick wall around the Colonial Williamsburg Capitol building; 1822 (NY), 2645

Parmotrema subisidiosum (Müll. Arg.) Hale – Common; bark of deciduous trees and tops of brick walls; 290 (NY), 1263

Parmotrema submarginale (Michaux) DePriest & B. Hale – Occasional; bark of deciduous trees; 907, 2213 (NY)

Peltigera horizontalis (Hudson) Baumg. – Occasional; sandy slopes in calcareous ravines; 1091

**Peltigera neopolydactyla* (Gyelnik) Gyelnik – Occasional; sandy slopes in calcareous ravines; 1090, 1745 (NY)

* "*Peltigera neopolydactyla* sensu lato" [taxonomy to be revised in a forthcoming publication] – Common; sandy soil in calcareous ravines; 1121, 1122, 1124, 1125, 1128 (NY)

**Peltigera phyllidiosa* Goffinet & Miadlikowska – Rare; sandy soil in a calcareous ravine; 2256

Peltigera praetextata (Flörke ex. Sommerf.) Zopf – Occasional; sandy soil in calcareous ravines; 2168

Peltigera rufescens (Weiss) Humb. – Rare; sandy soil in a calcareous ravine; 1267

**Pertusaria epixantha* R. C. Harris – Rare; *Fagus grandifolia* bark near Waller Mill Pond; 1201, 3647 (NY)

Pertusaria multipunctoides Dibben – Rare; bark in a calcareous ravine; 680

Pertusaria paratuberculifera Dibben – Common; bark of deciduous trees; 971, 1829 (NY), 2165

Pertusaria propinqua Müll. Arg. – Rare; bark of a deciduous tree; 1016

Pertusaria pustulata (Ach.) Duby – Common; bark of cultivated deciduous trees; 818 (NY), 1402

Pertusaria rubefacta Erichsen – Rare; bark of a deciduous tree; 968

Pertusaria subpertusa Brodo – Common; bark of deciduous trees; 399, 508 (NY)

Pertusaria texana Müll. Arg. – Common; bark of deciduous trees; 339, 389 (NY)

Pertusaria xanthodes Müll. Arg. – Common; bark of deciduous trees; 915 (NY), 2095

Phaeographis inusta (Ach.) Müll. Arg. – Common; bark of deciduous trees near lakes and rivers; 810 (NY), 933, 1130, 1434

Phaeophyscia adiastola (Essl.) Essl. – Common; mortar and concrete; 833

Phaeophyscia hirsuta (Mereschk.) Essl. – Abundant; mortar and concrete; 842, 1530 (NY)

**Phaeophyscia hirtella* Essl. – Common; mortar and concrete; 460, 1612 (NY)

Phaeophyscia rubropulchra (Degel.) Essl. – Abundant; bark and shaded brick; 375 (NY), 1515

**Phyllopsora corallina* (Eschw.) Müll. Arg. – Rare; bark in a calcareous ravine; 1483

Physcia millegrana Degel. – Common; bark of cultivated deciduous trees; 288, 2100 (NY)

Physcia pumilior R. C. Harris – Occasional; bark of cultivated deciduous trees; 1129, 1343 (NY)

Physcia stellaris (L.) Nyl. – Occasional; bark of deciduous trees; 2505

Physcia subtilis Degel. – Occasional; brick walls; 1273 (NY), 1280

Physciella chloantha (Ach.) Essl. – Common; mortar and concrete; 501, 1466 (NY)

**Physconia leucoleiptes* (Tuck.) Essl. – Occasional; brick walls; 2001

**Porina heterospora* (Fink) R. C. Harris – Rare; bark in a calcareous ravine; 2244

**Pseudosagedia cestrensis* (Michener) R. C. Harris – Common; *Liriodendron tulipifera* bark in calcareous ravines; 997

**Pseudosagedia rhaphidosperma* (Müll. Arg.) R. C. Harris – Rare; *Fagus grandifolia* bark at Waller Mill Pond; 826

**Punctelia missouriensis* G. Wilh. & Ladd – Common; brick walls, usually centered on mortar; 471, 1728 (NY), 2583

Punctelia rudecta (Ach.) Krog – Abundant; trees and brick walls; 384, 474, 2037 (NY)

Pycnothelia papillaria Dufour – Occasional; roadside soil; 85

**Pyrenula cuyabensis* (Malme) R. C. Harris – Rare; bark of a fallen deciduous tree; 1401

Pyrenula pseudobufonia (Rehm) R. C. Harris – Common; bark of deciduous trees; 723, 828 (NY)

**Pyrenula punctella* (Nyl.) Trevisan – Rare; bark of *Fagus grandifolia*; 2226

**Pyrenula subelliptica* (Tuck.) R. C. Harris – Common; bark of deciduous trees; 829 (NY), 883

Pyrrhospora varians (Ach.) R. C. Harris – Abundant; bark of all kinds; 342, 528 (NY), 1415

Pyxine subcinerea Stirton – Abundant; bark of deciduous trees and bricks; 505, 2102 (NY)

Ramalina americana Hale – Common; bark of cultivated trees; 1793

Rinodina maculans Müll. Arg. – Common; bark of all sorts; 308, 1345 (NY), 1436, 1896, 1897

**Rinodina papillata* H. Magn. – Rare; bark of a cultivated deciduous tree; 1346

Trapeliopsis flexuosa (Fr.) Coppins & P. James – Common; *Pinus taeda* bark and untreated pine wood; 2066 (NY), 2195, 2300, 2304

Trypethelium virens Tuck. ex E. Michener – Common; bark of *Ilex* sp. and *Prunus subhirtella*; 1127 (NY), 2416

Tuckermanella fendleri (Nyl.) Essl. – Occasional; bark of *Pinus taeda*; 1126, 1139 (NY)

Usnea mutabilis Stirton – Common; bark of deciduous trees; 700, 705, 1838 (NY)

Usnea pensylvanica Mot. – Occasional; bark of deciduous trees and shrubs; 1328 (NY), 2250

Usnea strigosa (Ach.) Eaton – Abundant; bark of deciduous trees; 394, 921, 1452, 2019 (NY)

**Verrucaria calkinsiana* Servít – Rare; mortar; 1293

**Xanthomendoza fallax* (Hepp ex Arnold) Søchting, Kärnefelt & S. Kondr. – Rare; concrete; 1187

Xanthomendoza weberi (S. Kondr. & Kärnefelt) L. Lindblom – Common; brick, mortar, and bark of deciduous trees; 1490, 1539 (NY), 1747

Xanthoparmelia plittii (Gyelnik) Hale – Occasional; brick and rock; 2444

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Bird Communities on Recently-logged and Mature Non-Industrial Private Forestlands in Virginia

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ABSTRACT

Most studies of bird community responses to logging in the eastern United States have occurred on government or industrial forestlands. Non-industrial private forestlands (NIPFs), however, represent the single largest forestland ownership category in the nation and the largest source of timber, particularly in eastern states. This study compares bird species abundance, richness, and composition on recently harvested NIPF stands with mature forest stands over three years during the early breeding season and peak spring migration in Virginia. A total of 79 bird species was observed on the study sites, 76 of which were observed on recently logged stands and 37 on control stands. Logged stands had approximately twice the mean bird abundance and 50% higher species richness, on average, than that of mature forest stands. Bird species abundance was negatively correlated with overstory (>10 m) tree cover and midstory (2-10 m) tree cover and positively correlated with herbaceous layer cover (<0.5 m) and the amount of large woody debris. Bird species abundance was not significantly correlated with shrub cover (0.5-2 m) or the abundance of snags. Relationships for species richness were similar except that species richness was not significantly correlated with overstory cover. Differences in species composition were evident among bird communities on logged and mature forest stands and were also affected by the intensity of logging.

Key words: biodiversity, forest management, logging, timber harvesting.

INTRODUCTION

Timber harvesting, often referred to as logging, can have significant impacts on wildlife species. Each species of wildlife has specific habitat requirements for food, water, cover, and nesting sites, and habitat conditions may be changed by timber harvesting. For example, logging will decrease the amount of overstory tree cover, but typically increases understory ground cover, understory food sources, and the amount of woody debris on the forest floor (Fredericksen et al., 2000; Brawn et al., 2001).

The response of birds to logging is of particular interest to many conservation biologists and natural historians. Bird species are useful indicators of habitat change (Balda, 1975). In addition, populations of many bird species have experienced steep declines in recent decades. There are particularly strong concerns about Neotropical migrants that breed in North American forests (Robbins et al., 1989; Peterjohn et al., 1995) and whether logging may negatively affect forest interior bird species, particularly those in already fragmented landscapes (Robinson & Robinson, 1999). On the other hand, many bird species that require early successional forest habitat are also in decline (Brawn et al., 2001; Dettmers, 2003; Sauer et al., 2005).

Results of studies exploring the impacts of logging and other silvicultural treatments have been mixed and highly species-specific (Sallabanks & Arnett, 2005). Most of our knowledge of how birds respond to timber harvesting comes from research on industrial forestlands or government-owned forestland. Much less is known about how birds and other wildlife species respond to logging on non-industrial private forestlands (NIPFs), which comprise the majority of all forestland in the eastern United States (Birch, 1996) and from which the majority of timber is harvested in the United States (Best & Wayburn, 2001). These properties are often small in size and are imbedded within fragmented landscapes (Best & Wayburn, 2001; Butler &

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Leatherberry, 2004). NIPFs are diverse and include forest stands within residential properties, farms, and hunting club lands.

As in most eastern states, the majority of all forestland in Virginia is owned by non-industrial forest landowners (Thompson & Johnson, 1996). In Virginia, the mean size of these forest tracts is 90 ha, but it is highly skewed towards small tracts, with 62% being less than 40 ha (Thompson & Johnson, 1996). This report describes the results of a three-year study to determine the impacts of logging and logging intensity on the early breeding season/spring migration abundance, species richness, and species composition of bird species at the interface between the southern Blue Ridge and Upper Piedmont physiographic provinces of Virginia. Bird species abundance and richness were also correlated with habitat variables including vegetation cover at different levels within the forest, coarse woody debris, and snags.

METHODS

Study Sites

A total of 18 forest stands were identified in each year of the study with harvest intensities ranging from no harvesting (100% of original overstory cover) to clearcutting (0% overstory cover) (Table 1). In 2004, eight recently-harvested stands (harvested within the past two years) and 10 mature forest stands were used in the study. In 2005 and 2006, there were nine harvested stands and nine mature forest stands that had no recent history of logging. Most of the same stands were used in all three years of the study. Care was taken to make sure that the forest stands were similar with respect to pre-harvest stand composition. Stands were dominated by naturally-regenerated hardwood tree species with some scattered White Pine (*Pinus strobus*) and Virginia Pine (*Pinus virginiana*). They were similar in size (12-40 ha) and landscape matrix (percentage of farms, fields, urban development, and forest).

Field Sampling

Bird species richness and abundance were estimated using point counts with a 40-m radius. There were four survey points in each stand, with each point separated by 100 m. Points were located systematically along a transect approximately through the center of each stand. All birds heard or seen within the point count area were recorded and identified to species. Counts were conducted from 0600-1000 h, and 2-4 stands were sampled each day. Point counts were not made during periods of rain or windy conditions. All points on each site were sampled twice between late-April and mid-May each year from 2004-2006, coinciding with the peak of bird migration through the area and the peak of bird song activity for most species as they establish territories on breeding grounds. This period of the year was considered to be the best time to sample bird density because they are more vocal when establishing territories and, hence, are more easily detected, and because the use of sites by spring migrants can also be evaluated. Data were summed over all census points for each census day and the average bird abundance derived from the average of the two census days in each year. Bird abundance was therefore expressed as mean abundance per sampling day per unit area. During the summer, another study examining mammal and herpetofaunal abundance allowed for additional presence/absence data to better estimate bird species richness during the growing season. Since the amount of time spent in each stand for all sampling activities (sampling of all wildlife groups) was approximately equivalent, bird species richness was derived from a list of all species heard or seen on the site throughout the entire sampling season, not just from those observed during point counts.

Habitat Sampling

Vegetation cover data were collected at 10 systematically random locations in each stand. Percentage overstory (>10 m tall) tree cover and midstory (2-10 m tall) cover were estimated using a transparent grid densiometer. Percentage shrub (0.5-2 m tall) cover and ground (<0.5 m tall) cover were estimated ocularly to the nearest 5% using a 1-m^2 sampling frame. At each sampling point, a prism count was conducted to estimate total live and dead (snag) tree basal area. Woody debris cover >5 cm in diameter was estimated using approximately ten 50-cm line-intercept transects within which the diameter of each woody debris item was measured. An index of woody debris was constructed using the sum of all woody debris diameters along transects.

Statistical Analyses

For species richness, species were counted if they were observed during formal sampling or if they were incidentally observed using the site during any visit to the site. The time spent on each site was roughly equivalent for all study sites allowing for comparisons of total species richness among sites. Analysis of variance was used to test the hypothesis of no difference between recently-logged and mature forest stands with respect to bird abundance or species

Table 1. Basal area and logging history of recently-logged and mature forest* stands in Franklin, Patrick, and Henry counties, Virginia.

Study Stand	Year of previous logging	Basal area $m^2 ha^{-1}$	Years sampled	Type of logging
Baker	2004	10.0	2005-6	Patch clearcutting/selective
Bowling	1960s	30.0	2004-6	Mature forest
Brubaker	2004	0.0	2005-6	Clearcut
Compton	2003	0.0	2004	Clearcut with site preparation
Ferrum Mtn.	1970s	24.5	2004-6	Mature forest
Ferrum Trail	1970s	26.5	2004-6	Mature forest
Ferrum Ridge	1970s	33.7	2004-6	Mature forest
Fredericksen	1960s	26.5	2004-6	Mature forest
Grice	2003	25.5	2004-6	Moderately selective
GT Lester	2003	2.7	2004-6	Heavy selective
Heck	1960s	36.2	2004-6	Mature forest
Hutchinson	1960s	30.0	2004	Mature forest
Kings Mountain	2003	5.0	2004-6	Heavy selective
Kitterman	1960s	40.0	2004-6	Mature forest
Naff	2003	23.8	2004-6	Moderately selective
Pettigo	1960s	32.2	2004-6	Mature forest
Potter	2002	17.0	2004	Moderately selective
Rocky Mt. 1	2003	16.5	2004-6	Heavy selective
Rocky Mt. 2	2004	10.0	2005-6	Heavy selective
Snow Creek	1960s	26.3	2004-6	Mature forest
Wagner	2003-4	12.0	2004-6	Heavy selective

*Indicates mature forest stand although light selective logging had occurred in some stands in the past (>30 years ago).

richness. Sampling year was included in the model. The natural logarithm of bird abundance was used because of unequal variances for bird abundance on recently-logged and mature forest stands. Pearson's correlation coefficient was used to test for the correlations between bird abundance and species richness with habitat variables. Differences were considered statistically different at $p \leq 0.05$, although p values ≤ 0.15 are reported to note trends towards statistical significance. Detrended correspondence analysis (DCA) was used to compare stands and stand-species associations with respect to bird species composition (PC-ORD, version 5, MJM software, Gleneden Beach, Oregon, USA).

RESULTS

Habitat Assessment

Recently-logged stands had nearly three times the percentage herbaceous layer cover and amount of large woody debris than mature forest stands (Table 2), while mature forest stands had three times the percentage overstory cover and twice the percentage midstory cover as logged stands. Percentage shrub cover and snag basal area were similar in logged and mature stands (Table 2).

Bird Abundance and Species Richness

A total of 79 bird species was observed on the study sites, of which 76 were observed in logged stands and 37 in mature stands. The Veery (*Catharus fuscescens*), Black-throated Blue Warbler (*Dendroica caerulescens*), and Rose-breasted Grosbeak (*Pheucticus ludovicianus*) were the only species found exclusively in mature forest stands. Logged stands had statistically higher mean bird abundance and species richness than mature forest stands despite the fact that two 1-year old clearcut stands had the lowest density and species richness of all stands during any given year (Fig. 1). Logged stands had approximately twice the mean bird abundance (5.79 ± 0.79) and 1.5X the species richness (21.79 ± 1.20), on average, than that of mature forest stands (abundance 2.83 ± 0.27; richness 15.24 ± 1.16) (Fig. 1). The Red-eyed Vireo (*Vireo olivaceus*) was, by far, the most common bird species observed in this study and occurred with almost identical abundance in both logged and mature forest stands (Table 3). The Scarlet Tanager (*Piranga olivacea*) and Tufted Titmouse (*Baeolophus bicolor*) were also commonly observed and had a similar abundance in both logged and mature forest stands (Table 3). These two were the only bird species observed in all 18 study stands during any given year.

Table 2. Mean percentage vegetation cover (± 1 standard error and range) at different forest layers, woody debris index, and snag basal area on recently-logged and mature forest stands in Franklin, Patrick, and Henry counties, Virginia.

Variable	Logged	Unlogged
Overstory cover (%)	27.0 ± 21.7 (0-55)	74.3 ± 15.0 (54-96)
Midstory cover (%)	35.0 ± 29.5 (0-84)	75.0 ± 12.1 (55-92)
Shrub layer cover (%)	28.0 ± 14.8 (7-53)	25.1 ± 16.4 (5-57)
Herbaceous layer cover (%)	51.3 ± 26.1 (13-78)	18.3 ± 11.5 (5-46)
Woody debris index	199.4 ± 51.1 (136-282)	68.2 ± 27.6 (18-107)
Snag basal area (m^2/ha)	0.16 ± 0.05 (0.05-0.45)	0.16 ± 0.02 (0.10-0.28)

Overstory cover included vegetation cover >10 m tall; midstory cover included vegetation cover >2 m tall and <10 m tall; shrub layer cover included vegetation cover >0.5 m tall and <2 m tall; herbaceous layer cover included vegetation cover <0.5 m tall. Means are presented with ± 1 standard deviation. Minimum and maximum values are included in parentheses.

Relatively common species with higher abundances on mature forest stands compared to logged stands included the Ovenbird (*Seiurus aurocapilla*), Wood Thrush (*Hylochicla mustelina*), and Acadian Flycatcher (*Empidonax virescens*). Other less abundant species showing a preference for mature stands included the Blue-headed Vireo (*Vireo solitarius*) and Yellow-billed Cuckoo (*Coccyzus erythropthalmus*).

A long list of species more common on logged sites compared to mature forest stands included American Redstart (*Setophaga ruticilla*), Mourning Dove (*Zenaida macroura*), Carolina Wren (*Thryothorus ludivicianus*), Blue-gray Gnatcatcher (*Polioptila caerulea*), Yellow-throated Vireo (*Vireo flavifrons*), American Goldfinch (*Carduelis tristis*), Indigo Bunting (*Passerina cyanea*), Eastern Towhee (*Pipilio erythrophthalmus*), Yellow-breasted Chat (*Icteria virens*), Red-bellied Woodpecker (*Melanerpes carolinus*), Brown Thrasher (*Toxostoma rufum*), Gray Catbird (*Dumetella carolinensis*), Hooded Warbler (*Wilsonia citrina*), Kentucky Warbler (*Oporornis formosus*), Prairie Warbler (*Dendroica discolor*), and Chipping Sparrow (*Spizella passerina*) (Table 3).

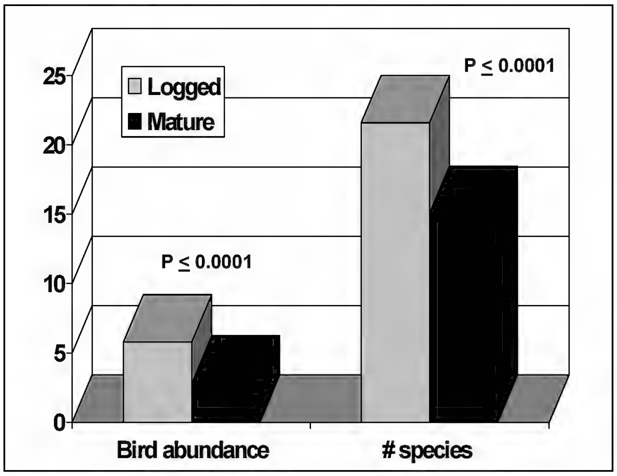

Fig. 1. Mean bird abundance (# birds/ha ± 1 standard error) and species richness (# bird species ± 1 standard error) on recently-logged and mature forest stands in Franklin, Patrick, and Henry counties, Virginia during 2004-2006.

DCA ordination axis 1 explained 51% of the variation in bird species composition among stands and axis 2 explained 23% of the variation. Recently logged stands were loaded on the right side of axis 1, with the most intensively logged stands appearing at the extreme end of the axis, and unlogged stands were clustered mostly to the left of axis 1 close to stands which had been partially cut (Fig. 2). Species on the ordination most closely placed with intensively logged stands included early-successional species such as Indigo Bunting, American Goldfinch, Prairie Warbler, and Gray Catbird. Bird species most closely associated with the left side of axis 1 included those typical of mature forests, such as Yellow-billed Cuckoo, Ovenbird, Acadian Flycatcher, Wood Thrush, and Blue-headed Vireo. Axis 2 is more difficult to interpret, although it may have been related to habitat patchiness, because two lightly selectively logged stands with a large amount of residual basal area interspersed with canopy gaps were isolated at the upper end of this axis (Fig. 2). Species most closely associated with these stands included Kentucky Warbler, American Redstart, Hooded Warbler, and White-breasted Nuthatch.

Relation of Bird Abundance and Species Richness to Habitat Variables

Bird species abundance was negatively correlated to overstory tree cover (Fig. 3) and midstory tree cover and positively correlated to herbaceous layer cover and large woody debris (Table 4). Bird species abundance was not significantly correlated with shrub cover. Relationships for species richness were similar except that species richness was not significantly correlated with overstory cover (Table 4). Similar results were obtained by using correlations of habitat variables with DCA ordination axes. DCA axis 1 was significantly and

Table 3. Mean bird density (# birds/ha ± 1 standard error) of bird species observed during point counts in recently-logged and mature forest stands in Franklin, Patrick, and Henry counties, Virginia during 2004-2006. An asterisk (*) indicates that species were observed on unlogged or logged stands at some point during the study although they were not detected during point counts.

Species	**Mature forest**	**Recently-logged**
Wild Turkey (*Meleagris gallopavo*)	0.02 (0.02)	0.02 (0.02)
Accipiter Species (*Accipiter* sp.)	0.00 (0.00)	0.00 (0.00)*
Northern Harrier (*Circus cyaneus*)	0.00 (0.00)	0.00 (0.00)*
Red-shouldered Hawk (*Buteo lineatus*)	0.00 (0.00)	0.00 (0.00)*
Broad-winged Hawk (*Buteo playpterus*)	0.00 (0.00)	0.00 (0.00)*
Red-tailed Hawk (*Buteo jamaicensis*)	0.00 (0.00)	0.02 (0.01)
Mourning Dove (*Zenaida macroura*)	0.00 (0.00)	0.06 (0.05)
Yellow-billed Cuckoo (*Coccyzus americanus*)	0.03 (0.03)	0.00 (0.00)*
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	0.00 (0.00)	0.00 (0.00)*
Ruby-throated Hummingbird (*Archilocus colubris*)	0.01 (0.01)	0.02 (0.01)
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	0.00 (0.00)	0.00 (0.00)*
Red-bellied Woodpecker (*Melanerpes carolinus*)	0.03 (0.03)	0.12 (0.05)
Pileated Woodpecker (*Dryocopus pileatus*)	0.01 (0.01)	0.00 (0.00)*
Northern Flicker (*Colaptes auratus*)	0.01 (0.01)	0.03 (0.03)
Downy Woodpecker (*Picoides pubescens*)	0.05 (0.03)	0.04 (0.01)
Hairy Woodpecker (*Picoides villosus*)	0.02 (0.01)	0.03 (0.02)
Eastern Kingbird (*Tyrannus tyrannus*)	0.00 (0.00)	0.00 (0.00)*
Great-crested Flycatcher (*Myiarchus crinitus*)	0.02 (0.02)	0.02 (0.01)
Eastern Phoebe (*Sayornis phoebe*)	0.01 (0.01)	0.05 (0.03)
Eastern Wood-Pewee (*Contopus virens*)	0.00 (0.00)*	0.04 (0.02)
Least Flycatcher (*Empidonax minimus*)	0.00 (0.00)	0.00 (0.00)*
Acadian Flycatcher (*Empidonax virescens*)	0.10 (0.05)	0.04 (0.04)
Willow Flycatcher (*Empidonax traillii*)	0.00 (0.00)	0.00 (0.00)*
American Crow (*Corvus brachyrhynchos*)	0.05 (0.03)	0.00 (0.00)*
Blue Jay (*Cyanocitta cristata*)	0.07 (0.03)	0.05 (0.02)
Carolina Chickadee (*Poecile carolinensis*)	0.07 (0.04)	0.11 (0.03)
Tufted Titmouse (*Baeolophus bicolor*)	0.17 (0.05)	0.18 (0.05)
White-breasted Nuthatch (*Sitta carolinensis*)	0.07 (0.03)	0.08 (0.05)
House Wren (*Troglodytes aedon*)	0.00 (0.00)	0.00 (0.00)*
Carolina Wren (*Thryothorus ludovicianus*)	0.05 (0.02)	0.13 (0.03)
Ruby-crowned Kinglet (*Regulus calendula*)	0.00 (0.00)	0.00 (0.00)*
Blue-gray Gnatcatcher (*Polioptila caerulea*)	0.01 (0.01)	0.16 (0.05)
Brown Thrasher (*Toxostoma rufum*)	0.01 (0.01)	0.08 (0.06)
Gray Catbird (*Dumetella carolinensis*)	0.00 (0.00)	0.07 (0.04)
Eastern Bluebird (*Sialis sialis*)	0.00 (0.00)	0.02 (0.02)
American Robin (*Turdus migratorius*)	0.00 (0.00)	0.01 (0.01)
Wood Thrush (*Hylocichla mustelina*)	0.26 (0.06)	0.12 (0.04)
Veery (*Catharus fuscescens*)	0.00 (0.00)*	0.00 (0.00)
Cedar Waxwing (*Bombycilla cedrorum*)	0.00 (0.00)	0.00 (0.00)*
Red-eyed Vireo (*Vireo olivaceus*)	0.86 (0.11)	0.85 (0.18)
Yellow-throated Vireo (*Vireo flavifrons*)	0.01 (0.01)	0.10 (0.06)
White-eyed Vireo (*Vireo griseus*)	0.00 (0.00)	0.05 (0.03)
Blue-headed Vireo (*Vireo solitarius*)	0.07 (0.05)	0.03 (0.02)
Warbling Vireo (*Vireo gilvus*)	0.00 (0.00)	0.00 (0.00)*
Black-and-white Warbler (*Mniotilta varia*)	0.02 (0.02)	0.03 (0.01)
Black-throated Blue Warbler (*Dendroica caerulescens*)	0.01 (0.01)	0.00 (0.00)
Yellow-rumped Warbler (*Dendroica coronata*)	0.06 (0.04)	0.10 (0.06)
Chestnut-sided Warbler (*Dendroica pensylvanica*)	0.00 (0.00)	0.00 (0.00)*
Pine Warbler (*Dendroica pinus*)	0.00 (0.00)	0.02 (0.02)
Prairie Warbler (*Dendroica discolor*)	0.00 (0.00)	0.06 (0.04)
Palm Warbler (*Dendroica palmarum*)	0.00 (0.00)	0.02 (0.02)
Yellow Warbler (*Dendroica petechia*)	0.00 (0.00)	0.00 (0.00)*
American Redstart (*Setophaga ruticilla*)	0.01 (0.01)	0.40 (0.23)
Blue-winged Warbler (*Vermivora pinus*)	0.00 (0.00)	0.00 (0.00)*
Worm-eating Warbler (*Helmintheros vermivorus*)	0.02 (0.01)	0.01 (0.01)
Canada Warbler (*Wilsonia canadensis*)	0.00 (0.00)	0.00 (0.00)*
Hooded Warbler (*Wilsonia citrina*)	0.06 (0.02)	0.12 (0.04)
Kentucky Warbler (*Oporornis formosus*)	0.00 (0.00)*	0.09 (0.05)
Common Yellowthroat (*Geothlypis trichas*)	0.00 (0.00)	0.02 (0.02)
Yellow-breasted Chat (*Icteria virens*)	0.00 (0.00)	0.22 (0.13)
Northern Waterthrush (*Seiurus noveboracensis*)	0.00 (0.00)	0.00 (0.00)*
Louisiana Waterthrush (*Seiurus motacilla*)	0.00 (0.00)	0.01 (0.01)
Ovenbird (*Seiurus aurocapilla*)	0.25 (0.07)	0.12 (0.09)
Brown-headed Cowbird (*Molothrus ater*)	0.00 (0.00)	0.03 (0.01)
Common Grackle (*Quiscalus quiscala*)	0.00 (0.00)	0.00 (0.00)
Orchard Oriole (*Icterus spurius*)	0.00 (0.00)	0.03 (0.01)
Baltimore Oriole (*Icterus glabula*)	0.00 (0.00)	0.00 (0.00)*
Summer Tanager (*Piranga rubra*)	0.00 (0.00)	0.00 (0.00)*
Scarlet Tanager (*Piranga olivacea*)	0.21 (0.09)	0.19 (0.10)
Northern Cardinal (*Cardinalis cardinalis*)	0.09 (0.03)	0.36 (0.14)
American Goldfinch (*Carduelis tristis*)	0.00 0.00)	0.28 (0.09)
Blue Grosbeak (*Guiraca caerulea*)	0.00 (0.00)	0.00 (0.00)*
Indigo Bunting (*Passerina cyanea*)	0.00 (0.00)*	0.38 (0.11)
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)	0.03 (0.03)	0.00 (0.00)
Eastern Towhee (*Pipilo erythrophthalmus*)	0.00 (0.00)*	0.33 (0.10)
White-throated Sparrow (*Zonotrichia albicollis*)	0.00 (0.00)	0.00 (0.00)*
Chipping Sparrow (*Spizella passerina*)	0.00 (0.00)	0.10 (0.07)
Field Sparrow (*Spizella pusilla*)	0.00 (0.00)	0.03 (0.02)
Song Sparrow (*Melospiza melodia*)	0.00 (0.00)	0.02 (0.02)
Unidentified Birds	0.12 (0.04)	0.31 (0.10)

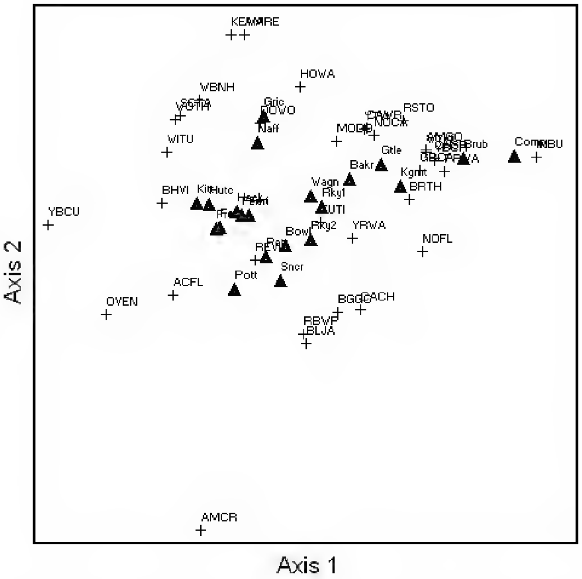

Fig. 2. Detrended correspondence analysis (DCA) ordination of bird species abundance on recently-logged and mature forest stands in Franklin, Patrick, and Henry counties, Virginia during 2004-2006. Solid triangles represent study stands and crosses represent species.

negatively related to percent overstory cover ($r = -0.85$, $p < 0.0001$) and percent midstory cover ($r = -0.80$, $p < 0.0001$) and positively correlated with percentage herbaceous layer cover ($r = 0.73$, $p = 0.001$) and amount of coarse woody debris ($r = 0.48$, $p = 0.04$). The most closely correlated habitat variables with DCA axis 2 were percent herbaceous layer cover ($r = 0.66$, $p = 0.003$) and coarse woody debris ($r = 0.63$, $p = 0.005$) (Fig. 2).

DISCUSSION

Logged stands had approximately twice the bird abundance and 50% higher species richness than mature forest stands. Several studies have documented high bird species abundance and species richness in early-successional forest habitats or higher species diversity in gaps, often as a result of logging (Chadwick et al., 1986; Welsh & Healy, 1993; Hagan et al., 1995; Greenberg & Lanham, 2001; Ross et al., 2002). Logging creates increased light to the forest floor, increasing the growth of plants and creating an increase in structural diversity in the understory. Along with increased woody debris created by logging, increased structural diversity in the vegetation provides more feeding and breeding habitat for many species of birds (Balda, 1975; Yahner & Smith, 1990; Greenberg & Lanham, 2001).

Table 4. Pearson's Correlation of bird species abundance and species richness with habitat variables in recently-logged and mature forest non-industrial private forestlands in Franklin, Patrick, and Henry counties, Virginia.

Variable	Bird Abundance		Species Richness	
	r	p	r	p
Overstory cover (%)	- 0.50	0.03	- 0.34	0.17
Midstory cover (%)	- 0.56	0.02	- 0.47	0.05
Herbaceous cover (%)	0.67	0.002	0.63	0.006
Shrub cover (%)	0.38	0.12	0.38	0.40
Woody debris index	0.81	$\leq$0.0001	0.81	$\leq$0.0001
Snag basal area	0.16	0.76	0.08	0.52

Bird species abundance and species richness increased with logging intensity in this study except for two very recent clearcuts. One of these clearcuts had been site-prepared and had very little vegetation and coarse woody debris had been skidded into large piles. Unfortunately, that stand was excluded from the study in 2005 because the owner decided to build a home on the property and it was replaced by a second clearcut in 2005. The replacement stand was completely clearcut in the Fall of 2004 with no trees >10 cm dbh remaining. In 2005, it had a very low bird abundance and species richness. However, in 2006, vegetation had recovered to the point where bird abundance and species richness were similar to the mean for all logged sites. The DCA ordination placed both of these stands at the extreme right of axis 1.

Similar to this study, Hagan et al. (1995) found that clearcuts initially have very low bird diversity. A large number of early successional bird species, however, appear to quickly colonize clearcut stands, which are otherwise rarely found in selectively logged or unlogged stands. In this study, these species included Chipping Sparrow, Yellow-breasted Chat, Field Sparrow (*Spizella pusilla*), Song Sparrow (*Melospiza melodia*), Eastern Bluebird (*Sialis sialis*), Prairie Warbler, White-eyed Vireo (*Vireo griseus*), Gray Catbird, Brown Thrasher, Indigo Bunting, Common Yellowthroat (*Geothylpis trichas*), American Goldfinch, and Eastern Towhee. Many of these species have been found to be area-sensitive shrubland birds that avoid edges (Rodewald & Vitz, 2005).

Some bird species in this study responded positively to logging, but tended to be most abundant in stands that were not intensively logged. These species included the Hooded Warbler, Kentucky Warbler, and the American Redstart, all of which breed in the study area. The DCA ordination placed these species at the upper terminus of axis 2. The Hooded Warbler has been described as a gap associate species (Greenberg & Lanham, 2001) and the American Redstart has also been associated with forest clearings (Yahner & Smith,

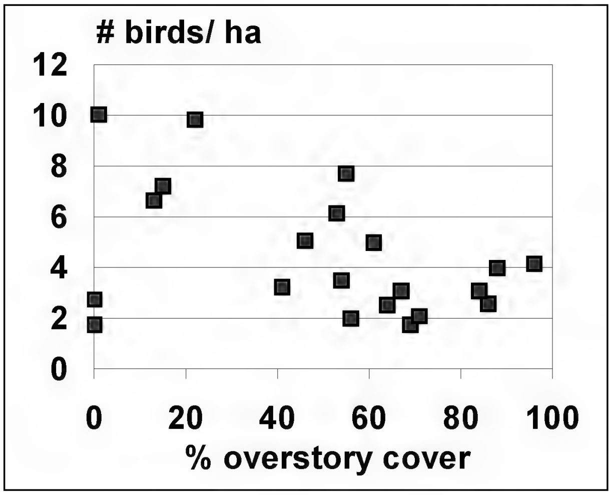

Fig. 3. Relationship between bird abundance and percentage overstory cover on recently-logged and mature forest stands in Franklin, Patrick, and Henry counties, Virginia during 2004-2006. The two stands at the bottom left of the chart are recent (<1 year-old) clearcut stands.

1990). While common in intensively logged stands as well, other species occurred commonly in selectively logged forest, including the Carolina Wren, Northern Cardinal, Blue-gray Gnatcatcher, and Yellow-throated Vireo. Interestingly, the Red-bellied Woodpecker (*Melanerpes carolinus*) was four times more abundant in logged stands compared to mature forest stands, although the abundances of both Downy (*Picoides pubscens*) and Hairy Woodpeckers (*P. villosus*) were similar among logged and mature forest stands.

As expected, Ovenbird and Wood Thrush were much more abundant on mature forest stands than logged stands and rarely occurred in intensively cut stands. Both of these species have been described as forest interior species (Ehrlich et al., 1988). Blue-headed Vireo and Acadian Flycatcher were also more common in mature stands than logged stands, but they did occur in some selectively logged stands. Interestingly, other birds considered to be forest interior species, including Scarlet Tanager and Red-eyed Vireo, had similar abundances on logged and mature forest stands. These species were even retained on intensively logged stands provided that there were small patches of mature trees left within the stand, such as along riparian areas.

Bird species abundance was negatively correlated with overstory tree cover and midstory tree cover and positively correlated with herbaceous layer cover and coarse woody debris. It is difficult to determine the relative importance of these relationships for habitat quality, however, because they are autocorrelated to some degree. Logging decreases overstory cover, thereby increasing light availability to the forest floor, which stimulates the growth of understory cover. The upper portions of trees and non-merchantable trees that are felled or toppled during the logging operation increase coarse woody debris on the forest floor, unless they are chipped, burned or otherwise disposed of following logging. Removal of woody debris occurred on only one stand in this study. Herbaceous layer cover and woody debris provide foraging habitat and cover for many species of birds (Titterington et al., 1979; Hagan et al., 1995).

It is not intuitively clear why midstory tree cover would be negatively correlated with bird abundance or species richness. Many intensively logged stands result in low overstory tree cover, but relatively high midstory cover. The retention of these trees may also provide perching, singing, cover, and foraging habitat for birds. On the other hand, an abundance of midstory cover may suppress herbaceous layer cover, which appears to be important for many bird species. It is also interesting that shrub layer cover was not correlated with bird abundance or species richness in this study given that many shrub and tree species respond positively to increased light availability following logging (Carter & Fredericksen 2007). Many unlogged stands in this study, however, had areas with relatively dense shrub cover consisting of Mountain Laurel (*Kalmia latifolia*) and Rhododendron (*Rhododendron* spp.).

There was little correlation between snag basal area and bird abundance or species richness in this study despite the fact that many studies find snag tree retention to be critical for retaining bird species richness in logged stands (Sallabanks & Arnett, 2005). I have personally observed, however, that loggers in the study area do not purposely fell snags, or other non-merchantable stems, although they may be toppled inadvertently by falling trees or logging machinery. Any loss of snag basal area due to toppling during the logging operation may perhaps be offset by the fact that some snags are likely to be created during logging due to root damage or other injuries to live trees. Indeed, mean snag basal area was identical in logged and mature forest stands (Table 2).

It is important to note several limitations of this study. First, the study only addressed bird species abundance during the early breeding season. Studies have documented habitat shifts during the breeding season for birds, particularly the use by fledglings of areas with dense vegetation, such as those created by logging, for bird species that tend to nest in mature forest (Anders et al., 1998; Vega Rivera et al., 1998; Marshall et al., 2003; King et al., 2006; Vitz & Rodewald, 2006). The impact on wintering habitat is also unknown. The timing of this study also coincided with spring migration during which birds are less selective of habitat or perhaps use different habitats than they do during the breeding season. Finally, this study did not document bird productivity differences due to logging or the intensity of logging. The presence of a bird species on a site does not indicate that it is also reproductively successful on that site (Brawn & Robinson, 1996), although studies have documented increases in bird productivity following logging in eastern forests (Ross et al., 2001; Weakland et al., 2002). Despite these limitations, this study is one of only a very few studies documenting the relative abundance, species richness, and composition of bird communities on recently-logged or mature non-industrial private forestlands.

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Land Snails of the Cheat River Canyon, West Virginia (Gastropoda: Pulmonata)

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ABSTRACT

The rich land snail fauna of the Cheat River Canyon in Monongalia and Preston counties, West Virginia, is reported. Sixty-six species were found in a 26 km segment of this steep-sided, forested valley. Snails of potential conservation interest include the central Appalachian Mountain endemics *Patera panselenus*, *Paravitrea petrophila*, *Stenotrema edvardsi*, and *Ventridens arcellus*, as well as the globally rare Cheat River Canyon endemic *Triodopsis platysayoides*. Other snails of possible local conservation interest are *Hendersonia occulta* and *Vertigo bollesiana*.

Key words: Cheat River Canyon, *Hendersonia occulta*, land snail, *Patera panselenus*, *Paravitrea petrophila*, *Stenotrema edvardsi, Triodopsis platysayoides, Ventridens arcellus, Vertigo bollesiana*, West Virginia.

INTRODUCTION

The Cheat River Canyon is a forested, steep-sided river valley in northern West Virginia. Efforts to locate and conserve the globally rare *Triodopsis platysayoides* Brooks, 1933, as well as other work to inventory natural resources on state and private lands over the past decade, have led to the discovery of a rich land snail fauna here. First collected at Coopers Rock near the north end of the canyon by M. Graham Netting of the Carnegie Museum of Natural History, *T. platysayoides* inhabits parts of the forested rock outcrops, boulder talus, and cave entrances within the northern three-quarters of the 26 km (16 mile) canyon. The canyon also provides refuge to a variety of central Appalachian Mountain endemic and rare species, including other land snails discussed below, plants, bats (including Indiana Bats [*Myotis sodalis*]) and other small mammals, amphibians, reptiles, and cave-dwelling aquatic invertebrates (West Virginia Division of Natural Resources, unpublished data).

Logging for charcoal and lumber, and associated small gauge railroad and road building, has affected most of the canyon at one time or another. Past strip mining of coal on the surrounding plateau has also altered slope drainage patterns. Despite these impacts, many areas have apparently escaped more intensive use due to their steepness and rock features, and large portions of the canyon forest have regenerated. However, in some parts of the canyon ongoing steep slope logging, skid trail and haul road development, and the spread of nonnative invasive plants such as Tree of Heaven *Ailanthus altissima* (Millspaugh), continue to change forest habitats.

Land snail inventory in West Virginia has been widespread, yet rarely intensive. Brooks & Kutchka (1938; later MacMillan, 1949) did early work on the state's Pupillidae. MacMillan (1949) monographed the state's entire land snail fauna, aided by a network of regional collectors. Approximately 160 species were recognized in West Virginia by Hubricht (1985), who collected throughout the eastern United States. The species-rich family Polygyridae was the focus of statewide work by Counts (1977) and some West Virginia collections are part of Emberton's work on Triodopsinae (1988) and Mesodontini (1991). In a rare example of geographically-intensive inventory, Taylor & Counts (1976) reported on the snails of Blennerhassett Island on the Ohio River.

STUDY AREA

The Cheat River drains more than 3,600 km^2 of the Appalachian Plateau in northeastern West Virginia, flowing north and west toward the Ohio River Valley. Watershed elevations range from approximately 1,500 m at its southern reaches, to 235 m at its confluence with the Monongahela River. The Cheat River Canyon, West Virginia, for purposes of this paper, is defined to be the approximately 26 km stretch from Albright, Preston County, downstream to Cheat Lake, Monongalia County (Figs. 1, 2). Elevations of ridgetops above the canyon rim range from 640 m (e.g., above Hacklebarney Run and at Coopers Rock and Snake Hill) to 268 m at Cheat Lake. The geology of the canyon consists of a series of Pennsylvanian and Mississippian age sedimentary rock strata deposited 300-350 million years ago (Cardwell et al., 1968). Pottsville Sandstone occurs at higher elevations, sometimes outcropping above steep slopes, and Pottsville talus is widespread on slopes all the way to river elevation. This formation is underlain by the softer, often reddish, Mauch Chunk. Beginning near Kingwood and continuing downstream, gray or whitish Greenbrier Limestone appears at mid-to-lower elevations, where caves and a variety of marine fossils occur. Mauch Chunk and Greenbrier outcrops and ledges are also frequent on steep slopes, at the head of debris chutes, and along ravines. Lowest are strata of Purslane (Pocono) Sandstone. The slopes of the Cheat River Canyon are mostly forested, with oaks (*Quercus* spp.) dominating drier sites, and cove hardwood or

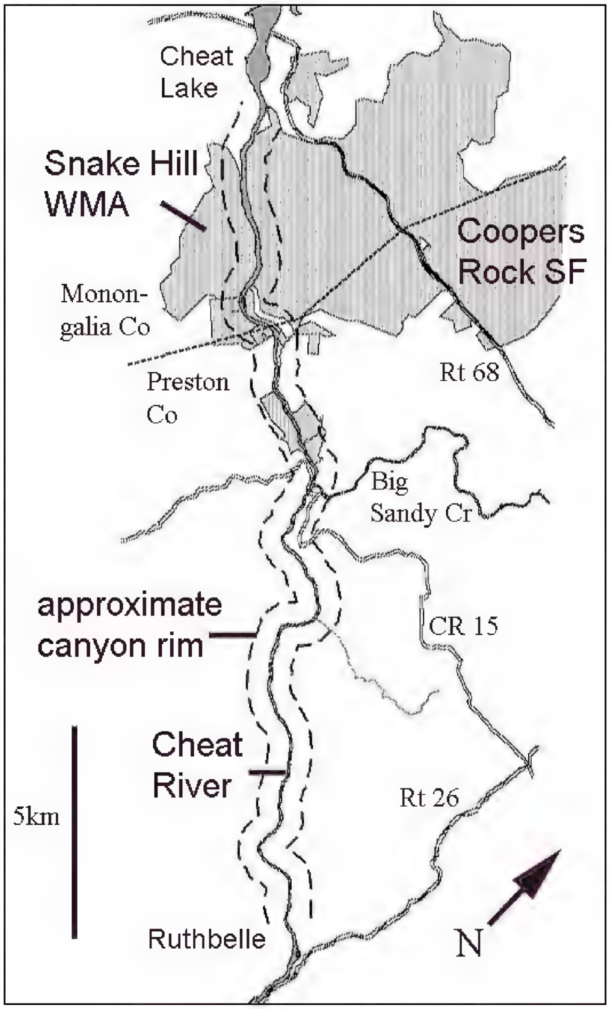

Fig. 1. Schematic map of the Cheat River Canyon, West Virginia. Public lands are shaded.

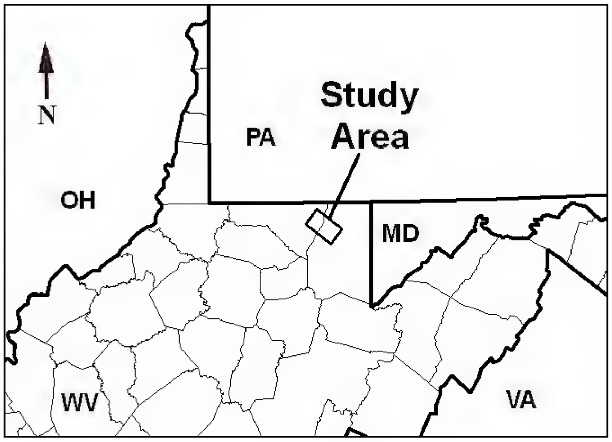

Fig. 2. A regional map of the study area.

Eastern Hemlock (*Tsuga canadensis* (L.) Carr.) stands in stream valleys and lower slopes. Understories sometimes include large stands of Great Laurel (*Rhododendron maximum* L.). Further description of the vegetation appears in Hotopp (2006).

METHODS

We conducted land snail inventories in the Cheat River Canyon from 1997 to 2006 (KPH), in 2004 (TAP), and in 2006 (DCD). Much of this inventory was incidental to work on the federally threatened *T. platysayoides* on state and private lands. These lands were those of Coopers Rock State Forest, Snake Hill Wildlife Management Area, and Allegheny Energy (of which parts are now owned by the state and a private timber company), totaling approximately 4,000 ha. Also, KPH inventoried land snails at the mouth of Cornwell Cave in 1998, at that time on Allegheny Energy property managed in cooperation with the West Virginia Chapter of The Nature Conservancy.

Snail collection was often focused on rock outcrops and talus where *T. platysayoides* might be found, but extensive collection during foot travel to and from rock features was also conducted. We visually inspected features such as tree trunks, coarse woody debris, herbaceous vegetation, and tree crotches, often with the aid of a flashlight. Sandstone and shale outcrops and overhangs, and limestone outcrops and cave entrances were frequently explored. Leaf litter was sometimes collected, in plastic bags, then later dried and sorted for land snails with the aid of a magnifying visor. Live land snails (except *T. platysayoides*) were drowned in tap water for 24 hours and then preserved in 70% ethanol. Land snails were identified using Emberton (1988, 1991), Hubricht (1976), and Pilsbry (1940-1948). Our taxonomy follows Millard (2003) and Roth (2003). Voucher specimens were deposited in the Carnegie Museum of Natural History mollusk collection (CM 67453, 67243-67256, 67280-67370, 67496-68689, 69815-69831, 70585-70725, 72574-72643, 73102, 73975-73989).

RESULTS

We documented 66 land snail species in the Cheat River Canyon, including many species of Polygyridae (13), Zonitidae (11), and Gastrodontidae (10) (Table 1). Distribution patterns of land snails varied greatly, with some species common and widespread, whereas others were restricted. While we did not quantify specific geographic distributions or associations between land snails and habitat, we offer here some qualitative observations.

Among the most abundant and widespread larger snails were *Mesomphix inornatus* (Say, 1821) and *Triodopsis tridentata* (Say, 1816), common in oak (*Quercus* spp.) and Sweet Birch (*Betula lenta* L.) leaf litter. *Anguispira alternata* (Say, 1816) was widespread. *Mesomphix cupreus* (Rafinesque, 1831) and *Neohelix dentifera* (A. Binney, 1837) were often found on mesic sites. *Stenotrema hirsutum* (Say, 1817) colonies were in mesic sandstone talus. *Appalachina sayana* (Pilsbry, 1906) and *Allogona profunda* (Say, 1821) were encountered on or near Greenbrier limestone, which was sometimes buried beneath sandstone talus. Large philomycid slugs were encountered in many places, but especially on poor soils, often with *Tsuga canadensis* and sandstone. *Discus patulus* (Deshayes, 1830) and *Strobilops* spp. occurred in typical colonies upon snags and woody debris. Tiny leaf litter snails were widespread but species richness was obviously greater on sites of middle-to-lower canyon elevations.

Regarding snails of potential conservation interest, *Triodopsis platysayoides* was found in more than 70 locations in the northern three-quarters of the canyon. These locations were mainly Pottsville sandstone features, both cliffs near the canyon rim, and talus locations at various elevations between the canyon rim and the river. The snail was also found in three places in or near Greenbrier limestone fissures. Most sites were forested and frequent woody plant associates were *Betula lenta* and *Rhododendron maximum*. Detailed field observations were provided to the West Virginia Division of Natural Resources.

Hendersonia occulta (Say, 1831) was found in the leaf litter at only a single Greenbrier limestone location in the southeastern part of the canyon. *Vertigo bollesiana* (E.S. Morse, 1865) (Fig. 3) also occurred in leaf litter in the same area on a few rich sites. The Appalachian endemics *Paravitrea petrophila* (Bland, 1883) and *Stenotrema edvardsi* (Bland, 1856) were encountered uncommonly, in forest litter on rich sites. *Ventridens arcellus* Hubricht, 1976 was found in litter on steep slopes. *Patera panselenus* (Hubricht, 1976) was patchily distributed, apparently restricted to damp rock features of sandstone, shale or limestone, typically ledges and overhangs, but also talus. The Cheat River Canyon population of *P. panselenus* is disjunct from other populations of this species in southern West Virginia, Virginia, and Tennessee (Hotopp, 2006).

Table 1. Land snails of the Cheat River Canyon, West Virginia. Taxonomy follows Millard (2003) and Roth (2003). Common names follow Turgeon et al. (1998).

Species	Common Name
Order Vetigastropoda	
Helicinidae	
Hendersonia occulta (Say, 1831)	Cherrystone Drop
Order Basommatophora	
Carychiidae	
Carychium exiguum (Say, 1822)	Obese Thorn
Carychium exile I. Lea, 1842	Ice Thorn
Carychium nannodes G.H. Clapp, 1905	File Thorn
Order Stylommatophora	
Cionellidae	
Cochlicopa morseana (Doherty, 1878)	Appalachian Pillar
Polygyridae	
Allogona profunda (Say, 1821)	Broad-banded Forestsnail
Appalachina sayana (Pilsbry, 1906)	Spike-lip Crater
Euchemotrema fraternum (Say, 1824)	Upland Pillsnail
Mesodon thyroidus (Say, 1816)	White-lip Globe
Mesodon zaletus (A. Binney, 1837)	Toothed Globe
Neohelix albolabris (Say, 1816)	Whitelip
Neohelix dentifera (A. Binney, 1837)	Big-tooth Whitelip
Patera panselenus (Hubricht, 1976)	Virginia Bladetooth
Stenotrema edvardsi (Bland, 1856)	Ridge-and-valley Slitmouth
Stenotrema hirsutum (Say, 1817)	Hairy Slitmouth
Triodopsis platysayoides (Brooks, 1933)	Cheat Threetooth
Triodopsis tridentata (Say, 1816)	Northern Threetooth
Xolotrema denotatum (Férrusac, 1821)	Velvet Wedge
Punctidae	
Punctum minutissimum (I. Lea, 1841)	Small Spot
Punctum vitreum (H.B. Baker, 1930)	Glass Spot
Discidae	
Anguispira alternata (Say, 1816)	Flamed Disc
Discus patulus (Deshayes, 1830)	Domed Disc
Helicodiscidae	
Helicodiscus parallelus (Say, 1817)	Compound Coil
Helicodiscus shimeki Hubricht, 1962	Temperate Coil
Lucilla singleyana (Pilsbry, 1890)	Smooth Coil
Euconulidae	
Euconulus fulvus (Müller, 1774)	Brown Hive
Euconulus polygyratus (Pilsbry, 1899)	Fat Hive
Gastrocoptidae	
Gastrocopta armifera (Say, 1821)	Armed Snaggletooth
Gastrocopta contracta (Say, 1822)	Bottleneck Snaggletooth
Gastrocopta corticaria (Say, 1816)	Bark Snaggletooth
Gastrocopta pentodon (Say, 1821)	Comb Snaggletooth
Order Stylommatophora (continued)	
Truncatellinidae	
Columella simplex (Gould, 1841)	High-spire Column
Strobilopsidae	
Strobilops aeneus Pilsbry, 1926	Bronze Pinecone
Strobilops labyrinthicus (Say, 1817)	Maze Pinecone
Vertiginidae	
Vertigo bollesiana (E.S. Morse, 1865)	Delicate Vertigo
Vertigo gouldi (A. Binney, 1843)	Variable Vertigo
Gastrodontidae	
Striatura exigua (Stimpson, 1850)	Ribbed Striate
Striatura ferrea E.S. Morse, 1864	Black Striate
Striatura meridionalis (Pilsbry & Ferriss, 1906)	Median Striate
Striatura milium (E.S. Morse, 1859)	Fine-ribbed Striate
Ventridens arcellus Hubricht, 1976	Golden Dome
Ventridens demissus (A. Binney, 1843)	Perforate Dome
Ventridens intertextus (A. Binney, 1841)	Pyramid Dome
Ventridens ligera (Say, 1821)	Globose Dome
Zonitoides arboreus (Say, 1816)	Quick Gloss
Zonitoides nitidus (Müller, 1774)	Black Gloss
Pristilomatidae	
Hawaiia minuscula (A. Binney, 1840)	Minute Gem
Arionidae	
Arion subfuscus (Draparnaud, 1805)	Dusky Arion
Philomycidae	
Megapallifera mutabilis (Hubricht, 1951)	Changeable Mantleslug
Pallifera dorsalis (A. Binney, 1842)	Pale Mantleslug
Philomycus carolinianus (Bosc, 1802)	Carolina Mantleslug
Philomycus flexuolaris Rafinesque, 1820	Winding Mantleslug
Philomycus togatus (Gould, 1841)	Toga Mantleslug
Haplotrematidae	
Haplotrema concavum (Say, 1821)	Gray-foot Lancetooth
Succineidae	
cf *Catinella vermeta* (Say, 1824)	Suboval Ambersnail
cf *Novisuccinea ovalis* (Say, 1817)	Oval Ambersnail
Zonitidae	
Glyphyalinia cumberlandiana (G.H. Clapp, 1919)	Hill Glyph
Glyphyalinia indentata (Say, 1823)	Carved Glyph
Glyphyalinia rhoadsi (Pilsbry, 1899)	Sculpted Glyph
Glyphyalinia wheatleyi (Bland, 1883)	Bright Glyph
Guppya sterkii (Dall, 1888)	Granule
Mesomphix cupreus (Rafinesque, 1831)	Copper Button
Mesomphix inornatus (Say, 1821)	Plain Button
Mesomphix perlaevis (Pilsbry, 1900)	Smooth Button
Nesovitrea electrina (Gould, 1841)	Amber Glass
Paravitrea multidentata (A. Binney, 1840)	Dentate Supercoil
Paravitrea petrophila (Bland, 1883)	Cherokee Supercoil

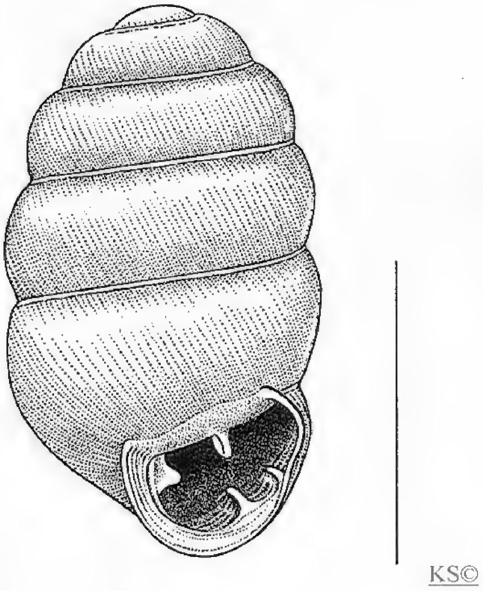

Fig. 3. *Vertigo bollesiana*, drawing by Kathleen Schmidt ©. The scale bar is 1 mm.

DISCUSSION

With 66 known species, the land snail fauna of the Cheat River Canyon harbors 41% of the approximately 160 species (MacMillan, 1949; Hubricht, 1985) found in West Virginia. Several central Appalachian Mountain endemic species are present. More extensive work would be needed to quantify the extent to which the land snail fauna of this canyon is exceptionally diverse or regionally unique, though the canyon does appear to be geologically distinct (relatively deeper and larger than nearby river valleys) and it is the only place in the world where *Triodopsis platysayoides* occurs.

For land snails of potential conservation interest, five are species restricted to the central and southern Appalachian Mountains. Their distributions in West Virginia are not completely known but they are not widespread. Two other species that are locally uncommon but that are more widely distributed in eastern North America were also included in this group. MacMillan (1949) reported West Virginia occurrences by county for five of these species of potential conservation interest; *H. occulta* from six counties; *P. petrophila* from six counties including Monongalia; *S. edvardsi* from 12 counties; *T. platysayoides* from Monongalia County; and *V. bollesiana* from three counties. The remaining two species were described after 1949.

Our species total approaches other reports of species-rich land snail assemblages. The geographically much larger Hiwassee River basin in Tennessee has 86 confirmed land snail species (Coney et al., 1982). Also larger, 22 counties along the western side of Lake Michigan had 82 species (Nekola, 2003). In Africa, a 1 km^2 patch of rainforest in Cameroon had 97 species (deWinter & Gittenberger, 1998). Smaller sites at Amboni Cave and near Amani in eastern Tanzania had 50 and 48 species, respectively (Emberton et al., 1997). By comparison, low species richness is found in areas such as the Southern Plains of Oklahoma and New Mexico, which had 26 species (Theler et al., 2004). Northwestern Minnesota was found to have 54 species (Nekola, 2002). In Europe, oligotrophic forest sites across southern Sweden yielded 38 species (Wäreborn, 1969), whereas calcareous woodlands across southern Britain harbored 57 species (Cameron et al., 2006).

Ultimately, however, simple comparisons of species richness between studies are difficult because of differences in methodologies and the geographic scale of inventoried areas. Also, such comparisons are of limited value by themselves, because they do not account for the identity of species, especially those that might be rare, endemic, or ecologically important.

We expect that further inventory work will expand and refine the list of land snails present in the Cheat River Canyon and nearby portions of the Cheat River watershed. There are several species for which identification is challenging and some for which taxonomy is uncertain. Smaller zonitid snails in genera such as *Glyphyalinia*, *Hawaiia*, and *Paravitrea* are in species-rich families with shells that are notoriously difficult to identify. For several species we had only a small number of specimens from which to make determinations. Identification of Succineidae snails is difficult without dissection or genetic analysis (Hoagland & Davis, 1987), which we did not perform. We have attempted to be conservative in this preliminary list by reporting only those species that are already described, and on whose identity we agree. We look forward to future discoveries in this valley and throughout the Cheat River watershed.

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Firefly (Coleoptera: Lampyridae) Flight Periods, Sex Ratios, and Habitat Frequencies in a United States Mid-Atlantic Freshwater Tidal Marsh, Low Forest, and their Ecotone

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ABSTRACT

As part of a long-term arthropod study, we operated six Malaise traps in Dyke Marsh Wildlife Preserve (DMWP), Virginia from April 1998 through December 1999 and obtained 727 adult lampyrid beetles in six genera. They were present in samples from early April through early October. The abundances of five of the genera varied among a low forest, freshwater tidal marsh, and the forest-marsh ecotone during at least 1 yr of the study. In genera with over 10 trapped specimens, four showed a male sex bias in combined samples from both years. Malaise traps can be used efficiently to survey and monitor certain lampyrid species in DMWP and similar places. To understand the lampyrid biodiversity and phenology of the Preserve more fully, it would be worthwhile to survey the entire Preserve for at least 10 yr.

Key words: beetles, deciduous forest, fireflies, Lampyridae, phenology, sex ratios, tidal freshwater marsh.

INTRODUCTION

Although fireflies (Coleoptera: Lampyridae) are common in many terrestrial environments throughout the world where they have several main roles in food webs, there are only a few published studies of lampyrid communities in particular habitats (e.g., Levesque & Levesque, 1997; Zaragoza-Caballero et al., 2003). Lampyrid larvae, which often live in moist areas, consume fallen fruit (e.g., *Sambucus* sp., *Vitis* sp.); are predators of annelids (Hirundinea, Oligochaeta), arthropods (e.g., flies [Bibionidae, Mycetophilidae], damselflies [Coenagrionidae], bugs [Membracidae], moths [Noctuidae, Notodontidae], and spiders [Salticidae]), and mollusks (Ancylidae, Philomycidae, Zonitidae); and are scavengers of dead insects (Keiper & Solomon, 1972; Buschman, 1984a, b). On the other hand, many organisms consume lampyrids including ants (Formicidae), antlions (Myrmeliontidae), bats (Chiroptera), birds (Anatidae, Caprimulgidae, Fringillidae, Hirundinidae, Icteridae, Nyctibiidae, Odontophoridae, Parulidae, Tyrannidae, Vireonidae), centipedes (Chilopoda), crustaceans (Armadilliidiidae, Cambaridae), fish (Cyprinidae), flies (Phoridae, Tachinidae), frogs and toads (Bufonidae, Hylidae, Ranidae), fungi, harvestmen (Sclerosomatidae), lizards (Iguanidae), other lampyrids (some *Photuris* spp.), mantids (Mantodea), mites (Acari), nematodes (Nematoda), snails (Gastropoda), spiders (Argiopidae, Araneidae, Lycosidae), true bugs (Belostomatidae, Reduviidae), and wasps (Crabronidae) (Lloyd, 1973; Lewis & Monchamp, 1994; EMB, pers. obs.).

Our study concerns lampyrids in a freshwater tidal marsh and adjacent floodplain forest of Dyke Marsh Wildlife Preserve (DMWP) in the Mid-Atlantic region of the United States. Our general aim in this study is to increase knowledge about the biology of lampyrids in view of conserving them. Specifically, we address the

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following questions by analyzing Malaise-trap samples. Which lampyrid taxa occur in DMWP? What are their flight periods? What are their abundances and sex ratios in three main Preserve habitats — floodplain forest, freshwater tidal marsh, and the ecotone between them? Are Malaise traps useful for surveying and monitoring lampyrids? Overall goals of our long-term DMWP research include discovering which arthropods occur in the Preserve and understanding its food web.

MATERIALS AND METHODS

As part of a long-term arthropod study, we collected lampyrids from April 1998 through December 1999 using six Townes-style Malaise traps (Townes, 1972) in Dyke Marsh Wildlife Preserve (DMWP), part of the George Washington Memorial Parkway, a national park in northern Virginia (Johnston, 2000). The Preserve includes 153.8 ha of land on the western shore of the Potomac River and part of the river in Fairfax County, Virginia. Elevation is 0–3.25 m asl (B. Helwig, pers. comm.). The Preserve, which contains the largest remaining freshwater tidal marsh in the Washington, DC, area, has experienced marked degradation in recent decades due to air pollution, alien invasive organisms, shoreline erosion due to boat wakes and storms, and water pollution (Johnston, 2000; Engelhardt, 2004; EMB, pers. obs.).

We placed two traps in each of three habitats — low forest, freshwater tidal marsh, and the ecotone between them as described by Barrows et al. (2004, Fig. 1). The six traps were in a broad transect that ran east to west. The ecotone (defined as 10 m on each side of the forest-marsh edge) ran about 200 m approximately NNE to SSW in our sampling area. We oriented each trap so that its longitudinal axis ran east-west, and its collecting head faced due east. The forest traps were about 50 m west of the ecotone, and the marsh traps averaged about 60 m east of the ecotone. The mid-point location of the traps in each habitat was 38.77194°N 77.05083°W (forest), 38.77139°N 77.05056°W (ecotone), and 38.77172°N 77.04990°W (marsh).

Each trap was 1.2 m wide, 1.7 m long, 1.0 m high at its back, and 2.0 m high at its front (Barrows et al., 2004, Fig. 2; Barrows & Kjar, 2008) and was made of crab-cage wire, a supporting metal frame, and a collecting head. We spray-painted trap gauze and supporting frames black in an attempt to decrease their visibility to lampyrids and human park visitors. The crab-cage wire encircled the base of each trap and prevented Snapping Turtles (*Chelydra serpentina*) and objects such as driftwood from tearing trap gauze. Each trap was mounted on a floating platform, 1.2 by 1.8 m, that rose up to 1 m above the ground when the tide entered the Preserve's marsh. Vertical metal poles kept traps in place as they moved up and down. Forest traps did not float because their sites did not flood during our study period, but can flood as high as 2.6 m. Lampyrids flew or crawled into a trap's collecting head where they were preserved in 95% ethanol. All traps ran during our entire 21-mo sampling period, except the marsh traps. We removed them from late December 1998 through late March 1999 because possible flooding during that time could have destroyed them. We emptied traps every 3–24 days, and we collected samples less frequently during the cold months when daily arthropod captures were low compared to warm months (Table 1).

We used the key in Downie & Arnett (1996) and obtained help from James E. Lloyd for specimen identification. Because of limitations of the key and the need to observe light flashes of *Photuris* spp. to make species identifications, we could not identify specimens of this genus to the species level. To test for possible differences in the number of lampyrids among habitats, we used repeated-measures analysis of variance (rmANOVA) and the Scheffé test (SPSS, Inc. 2006). To test for possible biased sex ratios in samples, we used Preacher's (2007) online Chi-square test program. Voucher specimens are in the Georgetown University Arthropod Collection.

Table 1. Lampyrid sampling intervals in Dyke Marsh Wildlife Preserve, Virginia, 1998–1999.

Sample interval	1998	1999
1	12–19 April	11–25 April
2	19–28 April	25 April – 8 May
3	28 April – 10 May	8–23 May
4	10–17 May	23 May – 6 June
5	17–28 May	6–20 June
6	28 May – 6 June	20 June – 2 July
7	6–14 June	2–18 July
8	14–24 June	18–23 July
9	24 June – 7 July	23 July – 8 Aug.
10	7–19 July	8–15 Aug.
11	19–30 July	15–29 Aug.
12	30 July – 9 Aug.	29 Aug. – 12 Sept.
13	9–12 Aug.	12–26 Sept.
14	12–28 Aug.	26 Sept. – 11 Oct.
15	28 Aug. – 11 Sept.	11–24 Oct.
16	11–26 Sept.	24 Oct. – 8 Nov.
17	26 Sept. – 11 Oct.	8–21 Nov.
18	11–26 Oct.	21 Nov. – 5 Dec.

RESULTS AND DISCUSSION

Lampyrid taxa

The Malaise traps captured 727 lampyrids during our 2-yr study. The samples contained *Ellychnia corrusca* (Linnaeus), *Lucidota atra* (Fabricius), *Photinus pyralis* (Linnaeus), *Pyractomena lucifera* Melsheimer, and *Pyropyga decipiens* (Harris), as well as at least three *Photuris* spp. that we could not identify by keying. There were 446 lampyrids in the 1998 samples and 281 in the 1999 samples (Table 2). All genera except *Pyractomena* were less common in 1999 compared to 1998. The observed yearly differences in lampyrid abundances might be the result of natural fluctuations in their population sizes due to weather and other factors. Based on information in Ulke (1902) and Downie & Arnett (1996), there may be as many as 32 lampyrid species in the combined area of Maryland, Virginia, and Washington, DC. This suggests that there may be more lampyrid species in DMWP than our traps captured and that hand collecting, use of other types of traps in addition to Malaise traps, and examination of living specimens may uncover more species and genera in DMWP.

In contrast to our study, a lampyrid survey in a *Rubus* 'Boyne' monoculture and adjacent forest dominated by *Pinus strobus* in southern Quebec, Canada, obtained six genera and eight species (Levesque & Levesque, 1997). A lampyrid survey in a tropical dry forest in the Sierra de Huautla Biosphere Reserve, Morelos, Mexico, found eight genera and 19 species (Zaragoza et al., 2003).

Flight Periods

In DMWP, lampyrid flight seasons varied among taxa (Table 2, Figs. 1–2). Collectively, lampyrids were captured from 19 April through 11 October, with peak abundance in July. Zaragoza et al. (2003) found a similar seasonal abundance distribution. Their lampyrids primarily flew during the rainy season in Huautla, which is approximately from June through September and roughly corresponds to the warm season of May through early October when lampyrids primarily flew in DMWP.

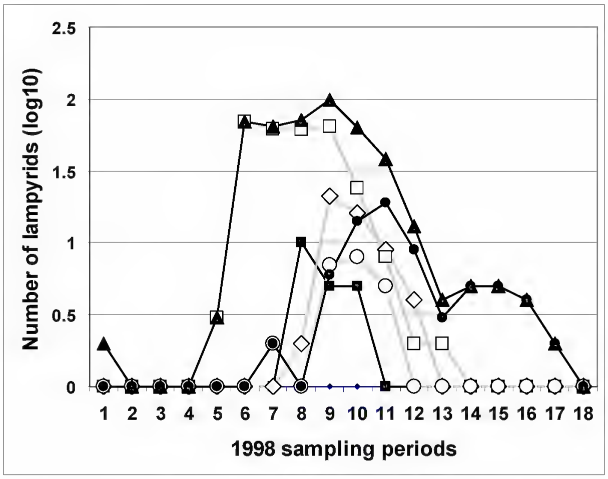

Fig. 1. Lampyrid abundance during the 1998 flight period, Dyke Marsh Wildlife Preserve, Virginia. See Table 1 for sampling periods. The black diamond represents *Ellychnia corrusca*; black square, *Lucidota atra*; open diamond, *Photinus pyralis*; open square, *Photuris* spp.; open circle, *Pyractomena lucifera*; black circle, *Pyropyga decipiens*; black triangle, all lampyrids.

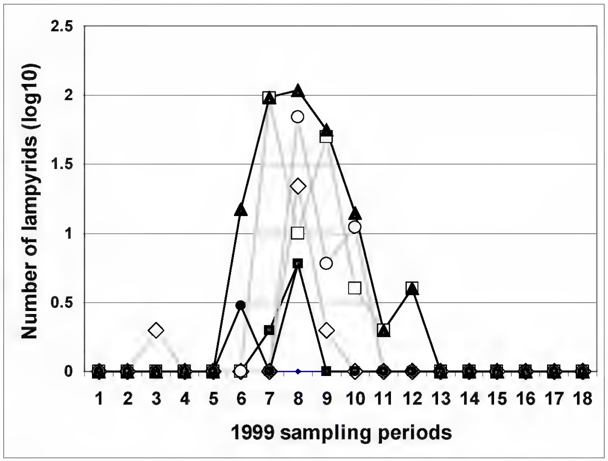

Fig. 2. Lampyrid abundance during the 1999 flight period, Dyke Marsh Wildlife Preserve, Virginia. See Table 1 for sampling periods and Fig. 1 for taxon symbols.

Abundances

As a group, DMWP lampyrids did not show abundance differences among habitats in either year (Table 2). *Lucidota atra* and *Photinus pyralis* were most common in the forest in 1998, and *Photuris* spp. and *Pyractomena lucifera* were most common in the ecotone in both years. Kjar & Barrows (2004) reported *Photinus* sp. and *Photuris* sp. larvae from pitfall samples of the DMWP forest. Little is known about the biology of most *Pyractomena* spp., but Buschman (1984b) noted that larvae of *Pyractomena lucifera* are aquatic and crawl on moist plants near water. This information and the abundance of *P. lucifera* in the DMWP ecotone suggest the hypothesis that adult *P. lucifera* in DMWP tend to stay in and near their

Table 2. Lampyrid abundance in three habitats based on Malaise-trap samples from Dyke Marsh Wildlife Preserve, Virginia, 1998–1999.

Taxon	Number of lampyrids[1]									Flight period, 1998–1999
	1998				1999				1998–1999	
	E	F	M	Total	E	F	M	Total	Total	
Ellychnia corrusca	0	0	1	1	0	0	0	0	1	12–19 April
Lucidota atra	1a	16b	0a	17	0	6	0	6	23	14 June – 19 July
Photinus pyralis	5a	42b	0a	47	1a	20a	2a	23	70	14 June – 9 Aug.
Photuris spp.	185a	55b	46b	286	129a	5b	28b	162	448	10 May – 12 Aug.
Pyractomena lucifera	32a	0b	4b	36	70a	0b	13c	83	119	6 June – 19 July
Pyropyga decipiens	17a	6a	36a	59	4a	0a	3a	7	66	14 June – 11 Oct.
All lampyrids	240a	119a	87a	446	204a	31a	46a	281	727	19 Apr. – 11 Oct.

[1] E = ecotone traps; F = forest traps; M = marsh traps. Within year and taxon, trap site totals (N = 2 traps) followed by different letters indicate that their respective sites have significantly different abundances from each other ($P \leq 0.05$), and totals followed by different letters indicate that their respective sites have significantly different abundances from one another ($P \leq 0.05$, rmANOVA, Scheffé test). The 1998 and 1999 sample for *E. corrusca* and the 1999 sample for *L. atra* are too small for Scheffé analysis.

larval habitat. Of the eight lampyrid species found in their trapping study, Levesque & Levesque (1997) obtained six or more specimens of *E. corrusca*, *L. atra*, and *Pyropyga decipiens*. They did not perform statistical analyses of species distributions among habitats; however, their raw data suggest the hypotheses that *E. corrusca* is more common in the boundary and forest than in the *Rubus* monoculture, and *L. atra* does not show a habitat preference. In our study, *L. atra* was most common in the forest. Furthermore, those researchers found that *P. decipiens* occurred only in the most open area (the *Rubus* monoculture), whereas in our study, this species was not statistically more abundant in open areas. Possible reasons for the differences in taxon distributions of these two studies include habitat-preference differences among populations within species and differences in sample sizes.

Sex Ratios

In 2-yr samples, adult sex ratios for *L. atra*, *Photinus pyralis*, *Photuris* spp., and *Pyropyga decipiens* are male biased (Table 3). *Photinus pyralis* shows a male bias in the forest; *Photuris* spp., ecotone and forest; and *P. decipiens*, forest and marsh. *Pyractomena lucifera* shows a female bias in the ecotone. These biases may be due to an actual preponderance of one sex in particular habitats, or, if a species or genus has an actual 1:1 adult sex ratio, a greater tendency for the traps to catch females or males depending on the taxon. Females of some *Photinus* species are brachypterous and do not fly, so Malaise traps might catch them only rarely, if at all.

Monitoring with Malaise Traps

Malaise traps may be the most effective trap type for collecting adult lampyrids of some species. For non-flashing species, pheromone traps (apparently not yet developed) may be highly successful. Lampyrids infrequently come to lights suggesting that light traps would be a poor means for collecting these beetles. In our study area, adult lampyrids of most species are usually hidden from dawn through dusk so it is difficult to collect them diurnally. It is also difficult to net lampyrids in the dark when they are flying and hand-collect them from foliage and other objects because they are usually hard to find.

We found that Malaise traps can obtain a large lampyrid sample, adequate for comparing species and genus abundances and adult sex ratios of some taxa

Table 3. Sex ratios of lampyrids by habitat based on Malaise-trap samples from Dyke Marsh Preserve, Virginia, 1998–1999.

Taxon	Habitat[1]							
	Ecotone		Forest		Marsh		All sites	
	N	% female	N	% female	N	% female	N	% female
Ellychnia corrusca	–	–	–	–	1[2]	100	1[2]	0
Lucidota atra	1[2]	0	22	14	–	–	23	17**
Photinus pyralis	6	33	62	5***	2[2]	100	70	10***
Photuris spp.	314	26***	60	22***	74	58	448	31***
Pyractomena lucifera	102	61*	–	–	17	41	119	58
Pyropyga decipiens	21	57	6	0*	39	26*	66	33**
All lampyrids	444	36***	150	13***	133	47	727	34***

[1] *$P \le 0.05$; **$P \le 0.01$; ***$P \le 0.001$ (Chi-square test).
[2] This sample is too small for Chi-square analysis.

among habitats and years. The traps can operate all day and readily obtain lampyrids with short daily flight times, short annual flight times, or both. Therefore, the traps are useful for determining the conservation status of readily-trapped taxa based on their sample population sizes. In a preserve of over 40.5 ha (100 acres) such as DMWP, six Malaise traps may not have significant adverse effects on lampyrid populations.

For many *Photuris* species, it is necessary to examine male light flashes to identify them to species (Downie & Arnett, 1996), but this is not possible with killing-type Malaise traps. To monitor the relative population sizes of such species, one could take censuses along transects or at random points when lampyrids flash, collect the males in traps that do not kill them and then observe their flash patterns, or both. A fast, inexpensive method for identifying large numbers of lampyrids by examining their nucleotide sequences would be a boon for lampyrid surveys.

Conclusions

Overall, we found that lampyrid genera often have different abundances in different DMWP habitats and female- or male-biased adult sex ratios based on Malaise-trap samples. Our study obtained baseline data to be used in monitoring and managing lampyrids in DMWP. Many lines of future research are needed to solve more mysteries about lampyrids, including a complete survey of species and their life histories and a long-term study of population fluctuations in different DMWP habitats in view of global climate change and its effects on biodiversity.

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SHORTER CONTRIBUTIONS

Banisteria, Number 31, pages 53-54
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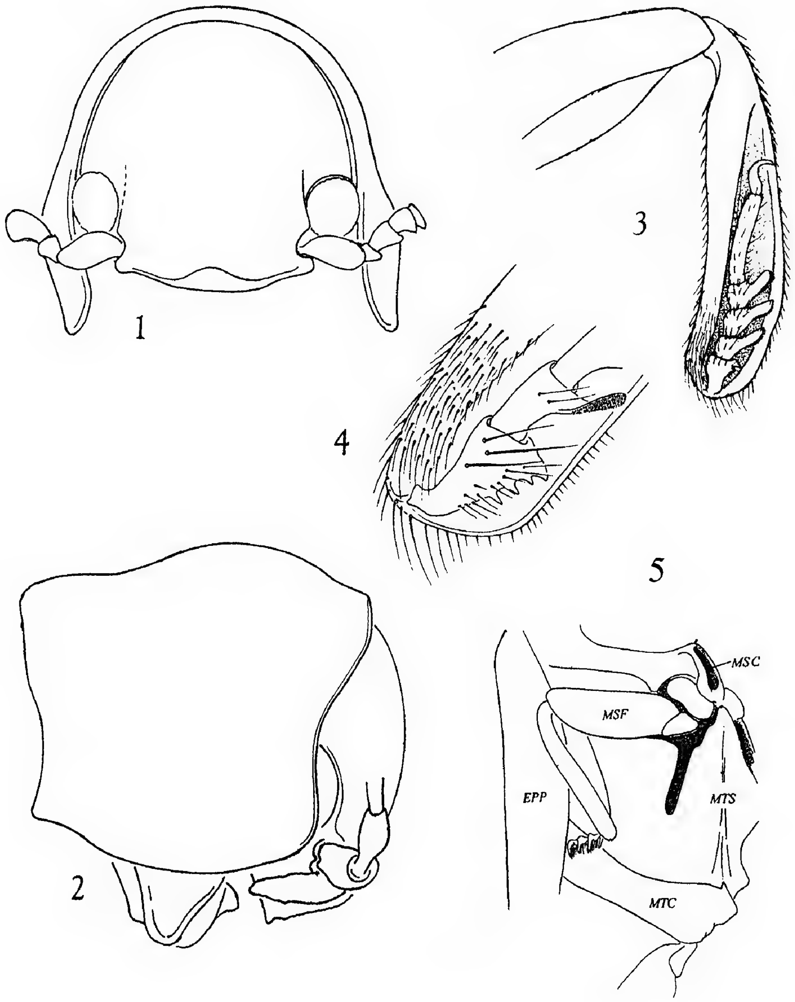
VIRGINIA RECORD FOR A RARE FALSE CLICK BEETLE (COLEOPTERA: EUCNEMIDAE).–Despite its relatively large size, *Dendrocharis inexspectatus* is certainly one of the rarest North American eucnemids, having been described (Muona, 2000) from only three specimens: two taken in Florida and one in Texas. The capture of two specimens in southeastern Virginia almost doubles the number of known specimens, in addition to extending the known range some 900 miles (1450 km) northeast from the Floridian sites. In putting this new information on record, I take the opportunity to provide some illustrations of important taxonomic characters and brief commentary on several features not treated in the original description.

Virginia: *City of Virginia Beach*: First Landing/Seashore State Park, 23 June - 6 July 2003, Robert Vigneault leg. (VMNH 2).



Dendrocharis inexspectatus Muona. Fig. 1. Front of head (mandibles not shown). Fig. 2. Head and prothorax, lateral aspect. Fig. 3. Protibia, posterior aspect, showing proportions of tarsomeres, their retraction into tibial convexity, and shape of ventral lamellae. Fig. 4. Distal end of protibia, enlarged, showing shape and armature of basal tarsomere. Fig. 5. Metasternal region, ventrolateral aspect of right side, showing appearance of tarsal grooves. The distal tarsomere of the second legs was missing and is not represented (abbreviations: EPP, epipleuron of right elytron; MSC, mesosternal cavity for reception of prosternal projection; MSF, mesofemur; MTC, metacoxa; MTS, metasternum). Figures 1, 2, and 5 drawn to the same scale, 3 - 4 enlarged.

With a robust, subcylindrical body up to 12 mm in length, *D. inexspectatus* ranks among the largest of Nearctic eucnemids. That it has been captured so seldom, and not at all in intensely sampled areas like eastern South Carolina (Kirk, 1969), suggests that either the species has very low population densities, occupies a niche not accessed by traditional collecting techniques, or has an extremely short period of adult activity. Maybe all three factors are operational in the case of this beetle.

Although eucnemids are considered by Muona (2000) to be "primitive polyphagan beetles", they share with elaterids the thoracic modifications for projecting the body upward ("the click mechanism") and various other character systems have become highly derived in some genera. *Dendrocharis* is strikingly distinctive from all other local genera of the family in several respects, most of which appear to suggest a cryptic, but not fossorial, life-style. The following features are noteworthy:

a. The eyes are small, and along with the broadly separated antennal sockets, set low on the front of the head (Fig. 1) with a deep round cavity centered in the interocular space.

b. The anterolateral region of the prothorax is distinctly lobed anteriad, partly covering the eyes (Fig. 2).

c. The dorsolateral antennal groove is "closed" posteriad, and remarkably deep, extending dorsad beneath the surface of the pronotum almost 1/3rd of the distance to the middorsal line.

d. The protibiae are broadened and deeply concave on the posterior face, forming a cavity into which the protarsomeres are hinged and held out of sight (Fig. 3); the profemora also are partially concave to accommodate the flexed tibiae, the two conjointly fitting into a deep groove on the posterolateral edge of prothorax.

e. The basal protarsomere is enlarged distally, with four distinct dentations along its ventral edge (Fig. 4), protarsomeres 2-4 are produced apically into narrow lamellae, finely pubescent on the ventral side.

f. The fifth metatarsomere is as long as the basal four combined, relatively much longer than in other genera.

g. The metasterna are unusually long and broad, each with a deep, narrow, sharp-edged groove (Fig. 5) which accommodates mesotarsi when the mesotibiae are reflexed into a shallow groove on the rear surface of the mesofemora.

Specimens of *Dendrocharis* cannot be identified in the key to genera in Muona's revision (2000: 10), owing to the contrast in couplet 8 "Abdomen with tarsal grooves" (leading to Dendrocharini) versus "Abdomen without tarsal grooves" (setting off genera in the tribes Eucnemini and Mesogenini). In actuality, there are no grooves on the abdominal sterna in *Dendrocharis,* specimens of which would therefore be carried on to an unresolvable limbo in one of the two tribes mentioned. Couplet 8 could be reworded to set off *Dendrocharis* by the presence of prominent deep grooves in the unusually large *metathoracic* sterna, not present in species of Eucnemini and Mesogenini. Changing the term "abdominal tarsal grooves" to "metathoracic sternal tarsal grooves" would correct the diagnostic statements for both tribe and genus on page 59.

ACKNOWLEDGEMENTS

I am very grateful to Dr. Jyrki Muona (Helsinki) for identifying the species and confirming the inadvertent statements in his revision about the presence of grooves on the abdominal sterna. That this beetle can be recorded for Virginia is due to the proficiency of Robert Vigneault (Oka, Ontario), *collecteur extraordinaire.*

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PREDATION STALEMATE: RED-TAILED HAWK (*BUTEO JAMAICENSIS*) VERSUS EASTERN RATSNAKE (*PANTHEROPHIS ALLEGHANIENSIS*).- Raptor predation on snakes has been well documented in the avian and herpetological literature (e.g., Guthrie, 1932; Fitch et al., 1946; Knight & Erickson, 1976; Brugger, 1989; Palmer & Braswell, 1995; Greene, 1997). Ernst (1992) and Ernst & Ernst (2003) noted 50 species of snakes in North America that had been killed by raptors. Only three species of snakes (*Agkistrodon contortrix*, *Pantherophis* [*Elaphe*] *alleghaniensis*, and *Nerodia erythrogaster)* have been documented as prey of hawks in the Virginia literature (Tupacz, 1985; Mitchell, 1994). We report here an observation of attempted predation by a raptor on a ratsnake in which the outcome did not result in death of the snake.

One of us (Fischer) observed such an encounter between a one year-old Red-tailed Hawk (*Buteo jamaicensis*) and an adult Eastern Ratsnake (*Pantherophis alleghaniensis*) on 6 March 2008 at the Norfolk Botanical Garden (NBG), Norfolk, Virginia. Her attention was drawn to a small clearing by a number of birds flying and diving at a hawk on the ground. The hawk's left wing was stretched out because the snake was wrapped around both of the hawk's legs and part of its body, and was pulling the hawk off balance. Both remained motionless while being photographed (Fig. 1). Fischer moved away to minimize disturbance and returned 36 min later to find that the snake had coiled itself around the hawk's neck and shoulder. The hawk had injured the snake behind its right jaw from which blood was dripping. Two NBG staff members arrived at that time and worked to release the hawk from the snake. The hawk was untangled and flew away, apparently uninjured. The snake was also released, apparently unharmed except for the injury to its head. During the attempted predation by the hawk, the snake was able to wrap itself around the predator enough to immobilize it and keep it from causing serious injury and death. Release of the hawk from the snake by NBG staff prevented us from knowing whether the snake would have eventually been killed or if the hawk would have been constricted and killed.

Although predatory strikes on snakes by hawks are usually fatal to the snake, some predation attempts result in fatality or immobilization of the predator instead of the intended prey. Several publications substantiate this observation. A Western Ratsnake (*Pantherophis* [*Elaphe*] *obsoleta*) wrapped its coils around the neck of a Red-shouldered Hawk (*Buteo lineatus*) in Texas and nearly killed the predator instead (Williams, 1951). In separate events in Florida and Massachusetts, Eastern Ratsnakes incapacitated Great Horned Owls (*Bubo virginianus*) by coiling around them (Forbush, 1927; Grimes, 1936). Perry et al. (2001) described mutual mortality of a Great Horned Owl and a Southern Black Racer (*Coluber constrictor priapus*) in Arkansas. Alynda Angstadt (pers. comm.) observed a *C. constrictor* incapacitate a Red-shouldered Hawk in Gloucester County, Virginia, on 1 September 2001, but in this case, the rangers at the park killed the snake to free the hawk. The Red-tailed Hawk in the predatory encounter documented here was an immature animal (B. Watts, pers. comm.). Its lack of experience as a snake predator undoubtedly contributed to its being overpowered by the ratsnake. Our observation in the Norfolk Botanical Gardens is the first published record in the Virginia literature of attempted predation resulting in an apparent stalemate for both predator and prey.

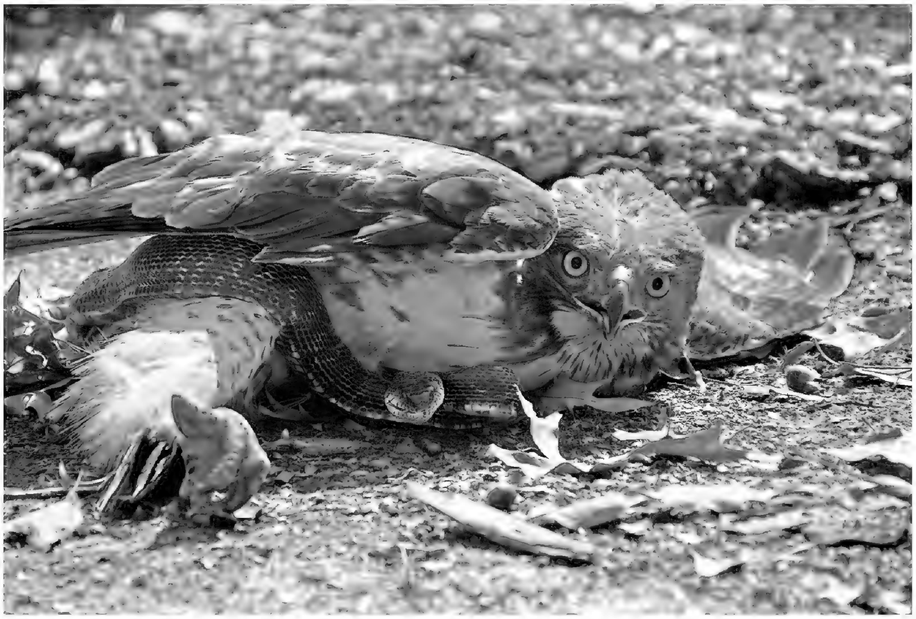

Fig. 1. Attempted predation by an immature Red-tailed Hawk (*Buteo jamaicensis*) on an adult Eastern Ratsnake (*Pantherophis alleghaniensis*) in the City of Norfolk, Virginia (photograph by G. Fischer).

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JCM thanks Bryan Watts for drawing the original web posting of the photographs to his attention and for confirming the bird identification. We also thank Alynda and Kory Angstadt for sharing their observations.

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COMMON RINGLET (*COENONYMPHA TULLIA*), A NON-NATIVE BUTTERFLY NEW TO THE VIRGINIA FAUNA.—There is an ever-growing body of literature documenting the adverse impacts of exotic (non-native) species on native floras and faunas around the world (e.g., Drake et al., 1989; Rodda et al., 1997; Mack et al., 2000; Mack & Lonsdale, 2001; Stohlgren et al., 2003; Brockerhoff et al., 2006; Strayer et al., 2006). This has prompted the formation of invasive species councils and databases at both the national (see U.S. Department of Agriculture, 2008) and state levels (including Virginia).

The known macrolepidopteran fauna of Virginia, comprised of approximately 1,300 species of butterflies, skippers, and (mostly) macromoths, includes only a half dozen or so species that are not native to the state. The most ubiquitous of these is the Cabbage White (*Pieris rapae*), a European import that has been present in the state since at least the 1870s (Clark & Clark, 1951), is a pest of cabbage and related vegetables, and can be extremely abundant (e.g., Taber [2003] reported that more than 33,000 adults were estimated to have been observed during a recent Fourth of July butterfly count on the Eastern Shore of Virginia). The European Skipper (*Thymelicus lineola*) was first recorded in Virginia in 1968 (Straley, 1969); it now occurs throughout the northern and western parts of the state, having expanded its range southward since its accidental introduction into Ontario in 1910 (Opler, 1998). This species is occasionally a pest of timothy grass (*Phleum pratense*), an agricultural crop.

Among the macromoths, the Gypsy Moth (*Lymantria dispar*), yet another European import, was first recorded in Virginia around 1980 and is a well-known pest whose voracious larvae consume upwards of 178,000 ha (440,000 acres) of tree leaves (primarily oaks) in the state annually (Virginia Tech, 2008). Despite aggressive suppression efforts by the Virginia Department of Agriculture and Consumer Services and the U.S. Forest Service's "Slow the Spread" program, this species continues to expand its range southward in Virginia (reaching Giles and Montgomery counties in the past few years).

Another recent European import is the Large Yellow Underwing Moth (*Noctua pronuba*). First documented in Virginia in 1998 (Roble et al., 1999), this species has expanded its range in the past decade to span the entire state (recent collections by staff of the Virginia Department of Conservation and Recreation, Division of Natural Heritage, range from Dickenson County in far southwestern Virginia to the City of Virginia Beach along the Atlantic Ocean). To date, we are not aware of any reports that defoliation by larvae of this species in Virginia has reached pest levels, but it was recently identified as a pest of hay (with at least one documented major defoliation event), and possibly vegetables, in Michigan (DiFonzo, 2007).

Other exotic macromoths known to occur in Virginia include the Ailanthus Silkmoth (*Samia cynthia*; present at least historically, but its current status in the state is unknown and it may be extirpated) and the noctuid *Anomis commoda,* both of Asian origin.

The increasingly popular but largely unregulated practice of releasing exotic butterflies, whether species not native to Virginia or populations of native species originating from other states, at weddings and other celebrations could potentially result in the establishment of exotic species if they can withstand the winter climate of Virginia (which will likely become more mild with global warming). Recent or future reports of tropical and subtropical species such as Queen (*Danaus gilippus*), Julia (*Dryas julia*), White Peacock (*Anartia jatrophae*), and Zebra (*Heliconius charitonius*) in Virginia should be carefully scrutinized because they may be the result of intentional releases rather than long distance movements by natural migrants or vagrants. The condition of any observed or captured individuals of these species may provide a clue as to their natural or artificial occurrence in the state, with worn individuals potentially more likely to have arrived here on their own and fresher ones more likely the result of releases.

The purpose of this note is to document the arrival of a new, non-native species of butterfly to Virginia, apparently due to an intentional translocation of the species outside of its natural range to a site near the Virginia border. On 7 August 2007, one of us (SMR) collected an adult Common Ringlet (*Coenonympha tullia*) in a beaver meadow bordering Buck Run in the Laurel Fork Recreation Area, George Washington National Forest, in extreme northwestern Highland County, Virginia. This site is within 0.5 km of the West Virginia state line. On 16 June 2008, MWD observed an adult Common Ringlet nectaring on Hawkweed (*Hieracium aurantiacum*) in a grassy meadow along Slabcamp Run, a nearby drainage less than 1 km farther south in the Laurel Fork Recreation Area. He returned to the site two days later and observed three more adults, vouchering one specimen. Our observations span two field seasons, thus suggesting that a reproducing population of Common Ringlets now inhabits the Laurel Fork Recreation Area.

The Common Ringlet is a Holarctic species that ranges from Alaska to Baja California in western North America, but only as far south as northern Wisconsin and Michigan east to southern Ontario, southern Quebec, the New England states and Long Island, New York in the East (Opler, 1998). Glassberg (1999) reported that the species did not originally occur in the northeastern United States, but has been expanding its range southward due to the appearance of a double-brooded population in eastern Canada in the early 1960s. It was first recorded in Maine in 1968, the lower Hudson River Valley in 1990, and New Jersey in 1994 (Cech & Tudor, 2005). Glassberg (1999) boldly predicted that it will eventually reach Georgia, whereas Cech & Tudor (2005; also D. F. Schweitzer, pers. comm.) noted that its rate of range expansion appears to have slowed during the past decade.

We are not aware of any previous reports of Common Ringlets in Virginia and our discovery of this species in the mountains raised doubts that this population was part of the expanding northeastern United States population. Several posts on a butterfly listserve as well as feedback from several butterfly enthusiasts lead us to conclude that the Virginia records of Common Ringlet represent recent emigrants from a population that was intentionally introduced at Spruce Knob Lake in eastern West Virginia (Randolph County near Pendleton County line). This site is 15-20 km north of the Laurel Fork Recreation Area. Apparently, an anonymous butterfly enthusiast translocated the species to the Spruce Knob area from New England within the past decade (the species was not recorded for West Virginia by Allen [1997]). Our specimens are assignable to the subspecies *Coenonympha tullia inornata* (Inornate Ringlet), which is known to inhabit the northeastern United States. Common Ringlets are reportedly now abundant around Spruce Knob Lake and we believe that this population has expanded via dispersing individuals to extend south across the West Virginia-Virginia border into the Laurel Fork Recreation Area. The recent arrival of this species into Virginia from the introduced population at Spruce

Knob Lake may obscure the documentation of the possible future arrival of the naturally expanding population from the Northeast. What impact, if any, the Common Ringlet will have on the native biota of the Laurel Fork Recreation Area or other parts of Virginia remains to be determined. Cech & Tudor (2005) characterized this species as an adaptive generalist with boreal affinities.

Voucher specimens of Common Ringlets from the Laurel Fork Recreation Area will be deposited in the Virginia Museum of Natural History, Martinsville.

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MISCELLANEA

Reviews

Wildlife of the Mid-Atlantic: A Complete Reference Manual by John H. Rappole. 2007. University of Pennsylvania Press, Philadelphia. 372 pp. $49.95 (cloth). www.upenn.edu/pennpress

According to the dust jacket, this is the 12th book authored (or edited) by Dr. John Rappole, a well-known and respected senior research scientist at the Smithsonian Institution's Conservation and Research Center in Front Royal, Virginia. One of his previous books, entitled *Birds of the Mid-Atlantic Region and Where to Find Them*, was reviewed in this journal (Bedell, 2003). The purpose of the present book is to serve as a compendium of information on the natural history, distribution, and conservation status of the vertebrate fauna, exclusive of fish and marine species, of the mid-Atlantic states (New Jersey, Delaware, Pennsylvania, Maryland, Virginia, and West Virginia). It is modeled after the work by Richard DeGraaf and his colleagues of the U.S. Forest Service on the terrestrial vertebrate fauna of New England (DeGraaf & Rudis, 1986; DeGraaf & Yamasaki, 2001). Rappole previously coauthored a book with DeGraaf (1995), whom he acknowledges for encouraging him to initiate this ambitious project. The result is a book that treats 546 "regularly occurring" species, including 72 amphibians, 62 reptiles, 331 birds, and 81 mammals (counting species accounts for feral dog, cat, horse, and pig). An appendix lists 136 additional species (123 are birds) that are classified as casual (87), accidental (32), or extirpated (17, including Ivory-billed Woodpecker). The putative hybrid Sutton's Warbler (Parula x Yellow-throated) is also included in this list.

The preface of this book is worth reading because Rappole argues that there is still a need for descriptive biological studies, particularly in relation to conservation issues and systematics. In the brief introductory chapter that follows he discusses the physical and biological characteristics of the region, including life zones, biotic provinces, habitats (10 examples are illustrated by black and white photographs), and wildlife conservation issues. The bulk of the book (8 x 10 inch format) consists of the species accounts, which include the following subheadings: description, habitat and distribution, habits, diet, reproduction (and life cycle for amphibians), range, and key references. Most species are illustrated by black and white line drawings (many were reproduced from the DeGraaf publications), but photographs (all black and white) are provided for a few. Several illustrations depict the external anatomy of birds (labeled with the associated terminology), but none are provided for amphibians, reptiles or mammals. The book concludes with a glossary (nearly 400 terms), bibliography (18 pages), and index (9 pages).

The species accounts (approximately two per page) are generally accurate but tend to be considerably less detailed than those in DeGraaf & Rudis (I consulted this reference [then available for free] periodically after moving to Massachusetts 20 years ago but have not seen DeGraaf & Yamasaki). Use of a smaller font and/or reduced spacing between lines (both are used in the bibliography and indexes) would have allowed for the inclusion of more information per species without increasing the size of the book. Rappole is an ornithologist and this bias is readily apparent. Since 60 percent of the treated fauna consists of birds, that portion of the text is well done. However, his knowledge of herpetology, and perhaps mammalogy also, is weaker. In hindsight, perhaps enlisting experts in herpetology and mammalogy as coauthors would have been resulted in a more accurate and complete compilation for those vertebrate groups.

A quick review of the bibliography revealed that seemingly 80-90 percent of the references consist of individual species accounts from the "Birds of North America" series (Poole & Gill, 1992-2002) sponsored by the American Ornithologists' Union, the Academy of Natural Sciences of Philadelphia (repeatedly cited as National Academy of Sciences, a different entity), and the Cornell Laboratory of Ornithology. By comparison, relatively few accounts from the "Mammalian Species" series produced by the American Society of Mammalogists are cited and there are none from the "Catalog of American Amphibians and Reptiles" series produced by the Society for the Study of Amphibians and Reptiles. In fact, Rappole makes a point to state that no such series exists for amphibians and reptiles.

Rappole apparently relied heavily on websites, such as those of NatureServe, the Virginia Department of Game and Inland Fisheries, and Marshall University's herpetology program, for much of the information presented on amphibians and reptiles other than salamanders. He frequently cites Petranka (1998) for the latter group, but apparently did not consult Ernst et al. (1994) or Ernst & Ernst (2003), among various recent compilations, for information on turtles and snakes, respectively. Also, the recent monumental volume on North American amphibians (Lannoo, 2005) is not cited, but perhaps this publication appeared after Rappole had completed his manuscript.

Except for the state books on reptiles (Mitchell,

1994) and mammals (Linzey, 1998), and a few selected species accounts in Terwilliger (1991; why weren't all of the accounts in this book consulted?), there are only a handful of published citations of direct relevance to Virginia (two papers on turtles and several from Rappole's research on birds). Not a single paper published in the state's regional journals (*Banisteria, Catesbeiana, The Raven*) is cited, nor are the recent herpetological (Mitchell & Reay, 1999) or breeding bird (Trollinger & Reay, 2001) atlases for Virginia. In fact, none of the state breeding bird atlases for the mid-Atlantic region is cited. The "Key References" listed for many species are websites rather than primary literature, and the actual best source often is not cited.

The glossary includes a few unexpected terms, such as acorn, beetle, and dragonfly, all of which I presume are familiar even to young children, whereas some others may be new to most readers (e.g., creche, spat). Rather unusual definitions include those for handstand, huddle, plow, and spin, whereas seta is very narrowly defined. Most entomologists no longer include cockroaches within the Order Orthoptera (now in Blattodea), and *Cupressus* is a strictly western genus of cypress in North America. I presume that Rappole is actually referring to bald cypress (*Taxodium distichum*), a tree characteristic of southeastern swamps. A few terms seem unnecessary (ardeid, ciconiiforms) and others (e.g., centipede, isopod, millipede) are poorly defined. Terms that might have been added to the glossary include cataract and paedomorphosis.

Most of the photos in the species accounts are of poor quality (e.g., Green Treefrog, Corn Snake) or were reproduced too dark, and are of little value. Some of the original drawings prepared for this book (particularly those of amphibians) seem to show awkward postures, profiles or atypical color patterns (e.g., several rails, Mabee's Salamander). Although there is a brief description and illustration (or photo) of every species included in the text, it is not a good source for making identifications. In reality, this book is intended to be a supplement to traditional field guides, so anyone interested in identifying the terrestrial vertebrates of the mid-Atlantic states should already own or purchase at least one good field guide for each taxonomic group.

County range maps are provided for amphibians, reptiles, and mammals, whereas Rappole uses more generalized maps (state outlines only) for birds in which he delineates summer, winter, migratory, and permanent residency distributions. The consistency and accuracy of the county maps for the non-avian species is highly variable. The maps for some species seem to have individual counties shaded strictly on the basis of actual confirmed records (the stated approach on page 17), whereas generous shading appears to have been used for others. The maps in Linzey (1998) are generally believed to rely heavily on the latter approach and likely were the source of the distributional information for Virginia mammals. This results in some unusual maps, such as that of the River Otter, which is shown to inhabit every county in Virginia but none in West Virginia (reportedly extirpated from this state and historical in Maryland, but for which most counties are shaded). The Eastern Harvest Mouse is listed as extirpated in Maryland, but the state is mentioned in the current range and at least six counties are shaded on the map. This inconsistency makes it difficult to determine if the maps are intended to show current or historical distributions. The map for Fisher lacks any Virginia records despite periodic sightings in Highland County and the purported record for Southeastern Myotis (a bat first found in [southeastern] Virginia in 1996; Hobson, 1998) in Lee County, our westernmost county, came as a complete surprise to me. The bird range maps seem to be more accurate, but that for Henslow's Sparrow does not show the Pulaski County population, perhaps the last remaining in the state (Titus et al., 1998).

Twelve species of amphibians and reptiles (as well as numerous mammals) are shown as occurring in every county in the mid-Atlantic region and nine others are mapped as occurring in every county of Virginia. Although most or all of these 21 species may indeed occur statewide, none has been formally documented from all 100 counties and county-sized cities (Mitchell & Reay, 1999). Both the Four-toed Salamander and Eastern Milksnake have been confirmed in only about half of the state's counties, and records are lacking from most western counties for the Marbled Salamander.

The range maps for the two species of gray treefrogs are misleading, as *Hyla versicolor* is shown to occur in every county in Pennsylvania whereas *H. chrysoscelis* is reportedly absent from that state. Examination of the distribution of the latter species in adjacent counties of neighboring states (especially West Virginia) suggests a different scenario. The map for the Cow Knob Salamander includes a disjunct, erroneous record in the Virginia Piedmont. The Black Bear map includes shading of all counties in the Virginia mountains, but dots in selected eastern counties of the state and there is no mention in the text of a resident population of this species in the Dismal Swamp region.

In general, the distributional (and life history) information for uncommon or rare amphibians and reptiles in Virginia seems to be a decade or two out of date. For example, the text and range maps for both the Chicken Turtle and Tiger Salamander are missing valid reports from Isle of Wight County and the Mole Salamander is now known from at least seven (not two) counties. There is a published study on the diet of larval

Mabee's Salamanders. The discovery of the Southern Chorus Frog (*Pseudacris nigrita*) in southeastern Virginia (Hobson & Moriarty, 2003), and the description of the Big Levels Salamander (*Plethodon sherando*) from Augusta County (Highton, 2004), were either overlooked by Rappole or perhaps published too late for these species to be included in this book. New "facts" that I learned about amphibians from this book are that Tiger Salamanders burrow in manure piles and Marbled Salamander larvae hibernate during winter. The description of the life cycle of the Mole Salamander is not entirely accurate.

Some of the mammal information is also dated, such as the statement that Rafinesque's Big-eared Bat is only known from five records in Virginia (now several dozen sites; see reference in Hobson, 1998). Text absent from the book which I expected to find includes the fact that muskrats regularly consume native freshwater mussels and Asian clams (often creating large midden piles, especially along river banks), and that raccoon populations have increased dramatically in the past half century, and may be abundant in suburbia.

As noted above, the accounts for salamanders seem to rely heavily on Petranka (1998). However, there is inconsistent treatment of new species recognized by genetic studies during the past few decades. For example, there is an account for the newly described *Plethodon montanus* and a listing of its nearest relatives in the "Jordan's Salamander complex", but Rappole does not recognize *P. chlorobryonis* or *P. cylindraceus* as distinct from *P. glutinosus* (Slimy Salamander Complex) nor *P. virginia* as distinct from *P. hoffmani* (Valley and Ridge Salamander), even though the same researcher (Richard Highton, University of Maryland) was responsible for recognizing all of these *Plethodon* species as distinct. Rappole also repeats Petranka's minority belief that *P. hubrichti*, *P. nettingi*, and *P. shenandoah* may be conspecific (decades ago that was thought to be true). This dichotomy in the acceptance or rejection of closely related species also exists for the genus *Eurycea*. There is only one account for Two-lined Salamanders (*Eurycea bislineata*); the name *E. b. wilderae* is briefly mentioned but *E. cirrigera* is not, despite the fact that all three are recognized as distinct species by many herpetologists. On the other hand, *E. guttolineata* and *E. longicauda* received their own species accounts, and *Desmognathus orestes* is recognized as a valid species. Since the publication of this book, the name *D. planiceps* has been resurrected for another distinct species in the foothills of the southern Blue Ridge Mountains (Tilley et al., 2008).

I commend Rappole for including a subheading entitled "conservation status" for each species. He includes the conservation ranks (defined on page 19) assigned by various state Natural Heritage Programs when appropriate. However, the problems with salamander taxonomy noted above lead to erroneous statements such as that *Eurycea bislineata* is rare (S2 rank) in Virginia. The Least Shrew is ranked S1 (very rare) in Pennsylvania and S2 in West Virginia, yet it supposedly inhabits every county in the 6-state region. There is no mention in the text that the Canebrake Rattlesnake is listed as state endangered in Virginia. Curiously, the accounts for both Pigmy (= Pygmy) and Weller's salamanders, inhabitants of high elevation spruce-fir forests in the Mount Rogers area of southwestern Virginia list acid rain, logging, and the spruce budworm (a moth caterpillar) as threats to their habitats. However, the Virginia ranges of both species lie entirely within portions of the Mount Rogers National Recreation Area where logging no longer occurs and the range of the spruce budworm is well to the north of Virginia, being no closer than northern Michigan and New York. Instead, the balsam woolly adelgid (*Adelges piceae*), a non-native insect pest, poses a more real threat to these forests, given its level of destruction of similar habitats in the southern Appalachians. For some species, I was a bit skeptical that the threats listed by Rappole were actually the leading ones. No mention is made of parasitism by raccoon roundworms as a threat to populations of the Appalachian (=Allegheny) Woodrat.

As with any book of this size, there are a few typographical errors (e.g., Gymonophiona, 40% N [latitude]). The names of Virginia counties seem to have fared especially poorly (e.g., Botetourot, Dickinson, Smith, Smythe). There are also numerous seemingly unnecessary hyphenations (e.g., dou-ble). The bibliography contains a few minor errors such as omission of the book title for Green & Pauley (1987) and a dubious publication date (1984) for the Peterson field guide to amphibians and reptiles by Roger Conant (there are 1958, 1975, 1991, and 1998 editions).

In his review of Rappole's previous book, Bedell (2003) raised the question of whether there was an available niche for it in the already crowded market of bird field guides. In the case of the present book, essentially one that begins where traditional field guides end and that also treats multiple vertebrate classes of a particular region, the "competition" is much more limited (only popular books such as Fergus, 2000 and 2003 come to mind). Consequently, Rappole's book really does fill a void and likely will be widely read. Despite the various shortcomings noted above, I believe this book will be of value to beginning naturalists, outdoor enthusiasts, students, teachers, and perhaps land managers. A considerable amount of information has been summarized in this book. Its value to more advanced naturalists and professional biologists, most of whom presumably already possess good natural history libraries, seems less certain. The cost of this book might hinder sales somewhat, but a paperback edition would undoubtedly sell much better.

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Richmond, Virginia 23219

Reports

1. President's Report

Plans are under way for the Society's Symposium on the **History of Natural History in Virginia**. The symposium will be held in late **September 2009** at the new Virginia Museum of Natural History in Martinsville. This will be a fascinating symposium covering the many scientists who have contributed to the long history of natural history in Virginia. We invite inquires from potential speakers, attendees, or cosponsors. Presentations given during the symposium will be published in book form or as a special issue of *Banisteria*. Consider attending, more details to come.

The Society is still accepting entries for our logo contest for the Virginia Natural History Society. This logo will be used in future publications, events, and possibly items for sale to give our society better recognition. **A $100 cash prize will be given** to the winning logo as selected by the executive committee. The words "Virginia Natural History Society" or the initials "VNHS" must appear in the logo. The winning artist must agree to transfer ownership and copyright of the logo to the Virginia Natural History Society. For more information and to submit entries contact: vhs.webmaster@verizon.net.

If you have a new email address or need to update your address please send me an email. The society is trying to update our email database so we can communicate better with our members.

Consider submitting a manuscript to *Banisteria* for publication. There are no printing charges for members. Also, get one or more of your fellow naturalists to join the Virginia Natural History Society.

Tom McAvoy (tmcavoy@vt.edu)
President, Virginia Natural History Society

2. Secretary/Treasurer's Report

As of June 30, 2008, the society has 120 members, including 18 institutions. Membership has declined over the past four years from the most recent high point in 2004, when we enrolled 165 members, including 22 institutions. This is an approximate 27% decline. Our current bank balance is $9,323.13.

As always, we encourage our present and active members to recruit members for the Society. A membership form is included with this mailing. Please pass it on to a friend or colleague interested in the natural history of our state.

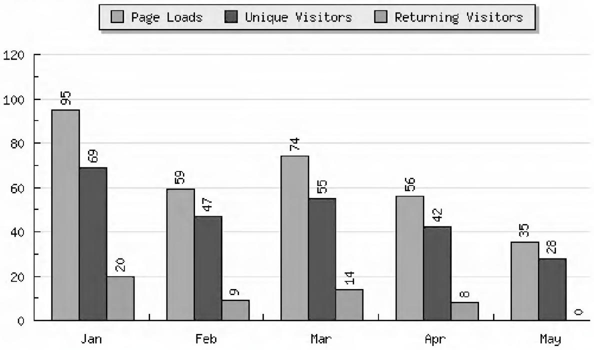
Please submit all enquiries about membership in the Society or about past issues of *Banisteria* to: Dr. William A. Shear, Virginia Natural History Society, Box 96, Hampden-Sydney, Virginia 23943, or email, wshear@hsc.edu.

Respectfully submitted,
William A. Shear, Secretary/Treasurer

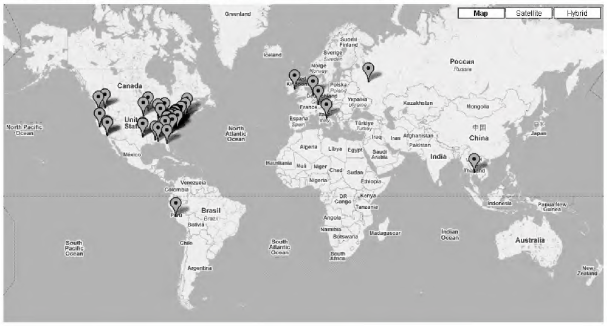
3. Webmaster's Report

One additional article was added from a past issue of *Banisteria*. The VNHS website currently consists of a total of 348 files and requires approximately 12.5 MB of server storage space. We would like to thank the Conservation Management Institute (www.cmiweb.org) for hosting the VNHS website.

Recent VNHS Website Traffic (January - May 2008):



Location of recent VNHS website users:



Respectfully submitted,
John White, VNHS Webmaster

4. Editor's Report

This is the first issue of *Banisteria* with a sole editor. Before continuing my report, I would like to thank Joe Mitchell for conceiving of, promoting, nurturing, and contributing many manuscripts to, this journal for the past 16 years. The assistance that was provided by Richard Hoffman during the first 8 years of the journal's existence was also critical. I appreciate their continued advice on the content and production of the journal. I would also like to thank Anne Lund for serving as the society's sole Secretary/Treasurer since its origin until her recent resignation.

As has been the norm in recent years, this issue took longer to finalize than desired because we still lack a backlog of accepted manuscripts. The future looks brighter because we plan to publish the Potomac Gorge Bioblitz summary report as the next issue of *Banisteria*, which will likely exceed 100 printed pages. This should provide the long-desired opportunity to develop a backlog of accepted papers. In fact, several manuscripts are currently in review for next spring's issue and I hope more will be submitted in the coming months.

I strongly encourage every member to attempt to recruit at least one new (or former) member to the society. Among several other reasons, I believe we need more members to justify the considerable time and effort involved in editing and producing *Banisteria*.

Respectfully submitted,
Steve Roble, Editor

Announcements

1. Elections

Bill Shear, Professor of Biology at Hampden-Sydney College, has agreed to seek relection as the society's Secretary/Treasurer this fall. completing the final year (expires in December, 2008) of Anne Lund's last four-year term. Anne stepped down as Secretary/Treasurer in December 2007 and recently retired from her faculty position at Hampden-Sydney.

We will also need to elect the society's next vice president and one new councilor this fall. If you are interested in serving the society in one of these positions, or would like to nominate another member, please contact Tom McAvoy at tmcavoy@vt.edu.

2. Virginia Herpetological Society – 50th Anniversary Meeting

The Virginia Herpetological Society (VHS), one of the oldest herpetological societies in the country, will celebrate its 50th anniversary during the weekend of October 4-5, 2008. The first day will feature oral and poster presentations at Virginia Commonwealth University (VCU) in Richmond. A field trip to VCU's Rice Center for Environmental Life Sciences is planned for the second day. For more details consult the VHS website at http://fwie.fw.vt.edu/vhs/.

3. New Tree ID Book Available

The Virginia Department of Forestry (VDOF) has published a new (2007) tree identification guide entitled "Common Native Trees of Virginia." This 120-page book is available exclusively from VDOF and can be purchased for $1 per copy plus shipping through the agency's website: http://www.dof.virginia.gov.

This is the most up-to-date and accurate version of this guide ever published (first edition printed in 1922). It contains descriptions, drawings, and range maps for each of the 78 most common trees, a dichotomous key for identification purposes, a list of other trees found in Virginia (including those regarded as invasive species), and information on VDOF's 17 state forests.

4. Proposed Symposium on Spruce-Fir Forests

In May 2009, the West Virginia University Division of Forestry and Natural Resources and the USDA Forest Service Northern Research Station are planning to host a symposium on the "Ecology and Management of High-Elevation Forests in the Central and Southern Appalachians," at Snowshoe Mountain Resort, near Slatyfork, West Virginia.

The objective of the meeting is to provide a comprehensive examination of the state of our knowledge about these imperiled forest communities and their components, along with trends for the future. Participation is invited not only from managers and researchers in the traditional natural resource fields of forestry, wildlife management, fisheries management, and recreation, but also those with training and perspectives in botany, conservation biology, ecology, economics, entomology, environmental engineering, mycology, political science, sociology, zoology, etc. Emphasis will be placed on forests dominated by boreal-montane conifers (spruce-fir), but contributions dealing with northern hardwoods or relict communities also will be welcomed.

Day one will consist of a plenary session with invited speakers across a broad spectrum of topics. Day two will feature concurrent sessions with contributed papers tailored to more specific groups. Day three will provide opportunities for field trips in the surrounding spruce forests. Invited and offered papers will be provided an opportunity to be published as a special session contribution in a journal (Forest Ecology and Management) or as conference proceedings through the Northern Research Station General Technical Report series.

Please indicate your interest in the conference by sending a message to this email address: SpruceConference@mail.wvu.edu.

Virginia Natural History Society
Website: va-nhs.org

General Information

The Virginia Natural History Society (VNHS) was formed in 1992 to bring together persons interested in the natural history of the Commonwealth of Virginia. The VNHS defines natural history in a broad sense, from the study of plants, animals, and other organisms to the geology and ecology of the state, to the natural history of the native people who inhabit it. The goals of the VNHS are to promote research on the natural history of Virginia, educate the citizens of the Commonwealth on natural history topics, and to encourage the conservation of natural resources. Dissemination of natural history information occurs through publication of the journal *Banisteria*, named for John Banister (1650-1692) who was the first university-trained naturalist to work in Virginia. The first issue was published in 1992, and the journal is published twice per year in spring and fall. Articles cover a wide array of subjects, and prospective authors are encouraged to submit manuscripts on any aspect of natural history in Virginia; book reviews and biographies of relevance to natural history in Virginia are also welcomed. The editor of *Banisteria* will also consider manuscripts on any aspect of natural history from neighboring states if the information concerns a species native to Virginia or the topic is directly related to regional archaeology, anthropology, botany, ecology, zoology, paleontology, geology, geography, or climatology. Manuscripts are peer-reviewed for suitability and edited for inclusion in the journal. Page charges ($15/page) are waived for VNHS members. The society's website contains instructions for authors, the titles (and abstracts beginning in 2004) of all *Banisteria* papers, and downloadable versions (PDF format) of numerous articles from past years.

Memberships

The VNHS is open to anyone with an interest in natural history and welcomes participation by all members in society activities and efforts to promote education and conservation. Membership includes a subscription to *Banisteria* and invitations to periodic symposia and BioBlitz surveys. Annual dues for members are $20 (per calendar year); library subscriptions are $40 per year. Checks should be sent to the Secretary/Treasurer, who also has back issues of *Banisteria* available at $10.00 each (except Nos. 1-6 are $5.00 and No. 13 is $18.00). The VNHS is a tax-exempt, nonprofit, society under Section 501(C)3 of the IRS. We welcome donations to support our mission in Virginia.

The Virginia Natural History Society
Application for Membership

Name ________________________________

Address________________________________

____

____

Zip Code ____________________________

Phone ______________________________

Email ______________________________

Area(s) of Interest ______________________

ANNUAL DUES AND SUBSCRIPTIONS TO *BANISTERIA*

(memberships and subscriptions are by calendar year; subscribers/members outside the United States should add $3.00 for additional postage)

☐ $500.00 Life (not annual)
☐ $300.00 Benefactor
☐ $100.00 Patron
☐ $50.00 Supporting
☐ $40.00 Institutional
☐ $25.00 Family
☐ $20.00 Regular
☐ $5.00 Student (see below)

☐ I have added a contribution of $______ to my membership dues.

The special student rate is applicable only when accompanied by the following certification signed by a faculty advisor.

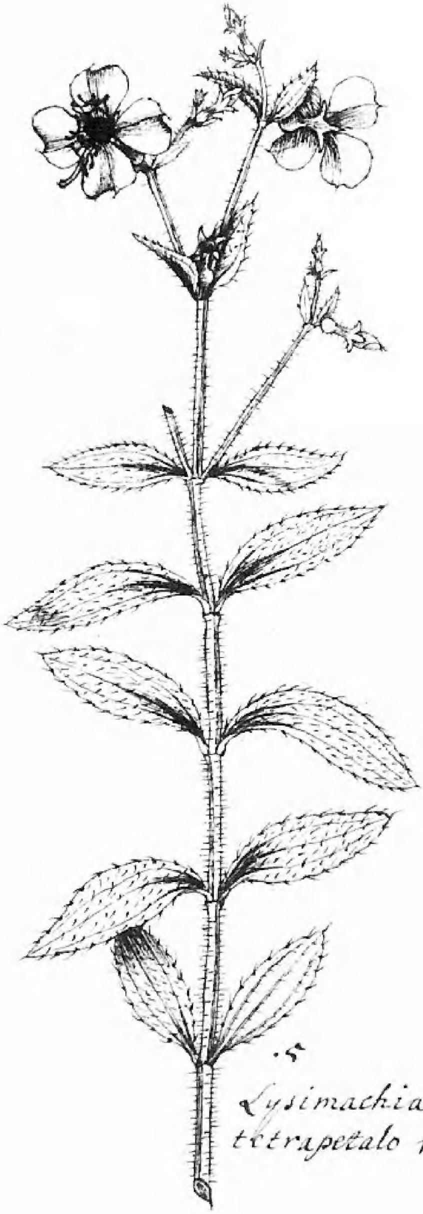
Institution ________________________

Advisor ___________________________

Date______________________________

Make checks or money orders payable to:
Virginia Natural History Society

Send membership form and dues to:
Dr. William Shear, Secretary-Treasurer
Virginia Natural History Society
Box 96
Hampden-Sydney, Virginia 23943



Lysimachia flore tetrapetalo rubello.